



wwPDB X-ray Structure Validation Summary Report ⓘ

May 15, 2020 – 07:10 pm BST

PDB ID : 6GAN
Title : Structure of fully reduced Hydrogenase (Hyd-2) variant E14Q
Authors : Carr, S.B.; Armstrong, F.A.; Evans, R.M.
Deposited on : 2018-04-11
Resolution : 1.60 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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
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

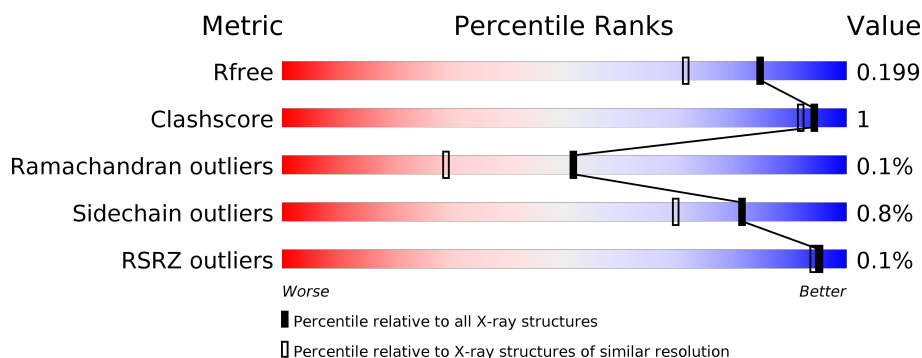
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION





The reported resolution of this entry is 1.60 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	3398 (1.60-1.60)
Clashscore	141614	3665 (1.60-1.60)
Ramachandran outliers	138981	3564 (1.60-1.60)
Sidechain outliers	138945	3563 (1.60-1.60)
RSRZ outliers	127900	3321 (1.60-1.60)

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 $\leq 5\%$. 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	S	301	 86% 11%
1	T	301	 87% 11%
2	L	567	 91% 6%
2	M	567	 92% 5%

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 13848 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 Hydrogenase-2 small chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	S	267	Total	C	N	O	S	0	1	0
			2037	1291	360	373	13			
1	T	267	Total	C	N	O	S	0	1	0
			2037	1290	359	375	13			

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
S	294	ARG	-	expression tag	UNP P69741
S	295	SER	-	expression tag	UNP P69741
S	296	HIS	-	expression tag	UNP P69741
S	297	HIS	-	expression tag	UNP P69741
S	298	HIS	-	expression tag	UNP P69741
S	299	HIS	-	expression tag	UNP P69741
S	300	HIS	-	expression tag	UNP P69741
S	301	HIS	-	expression tag	UNP P69741
T	294	ARG	-	expression tag	UNP P69741
T	295	SER	-	expression tag	UNP P69741
T	296	HIS	-	expression tag	UNP P69741
T	297	HIS	-	expression tag	UNP P69741
T	298	HIS	-	expression tag	UNP P69741
T	299	HIS	-	expression tag	UNP P69741
T	300	HIS	-	expression tag	UNP P69741
T	301	HIS	-	expression tag	UNP P69741

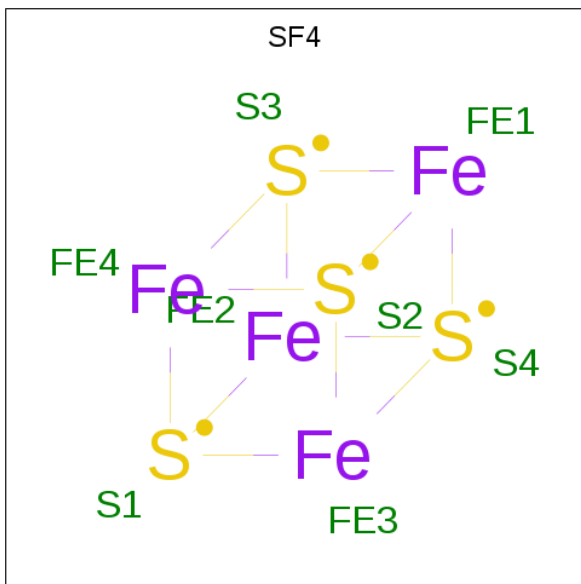
- Molecule 2 is a protein called Hydrogenase-2 large chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	L	551	Total	C	N	O	S	0	6	0
			4317	2747	742	810	18			
2	M	551	Total	C	N	O	S	0	6	0
			4327	2755	745	809	18			

There are 2 discrepancies between the modelled and reference sequences:

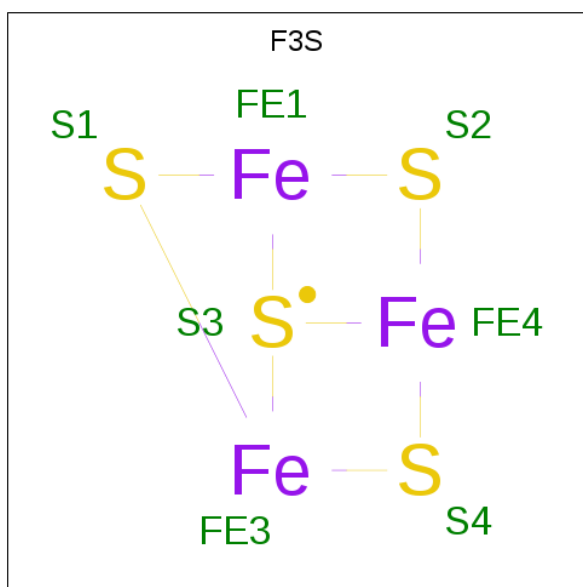
Chain	Residue	Modelled	Actual	Comment	Reference
L	14	GLN	GLU	variant	UNP P0ACE0
M	14	GLN	GLU	variant	UNP P0ACE0

- Molecule 3 is IRON/SULFUR CLUSTER (three-letter code: SF4) (formula: Fe_4S_4).



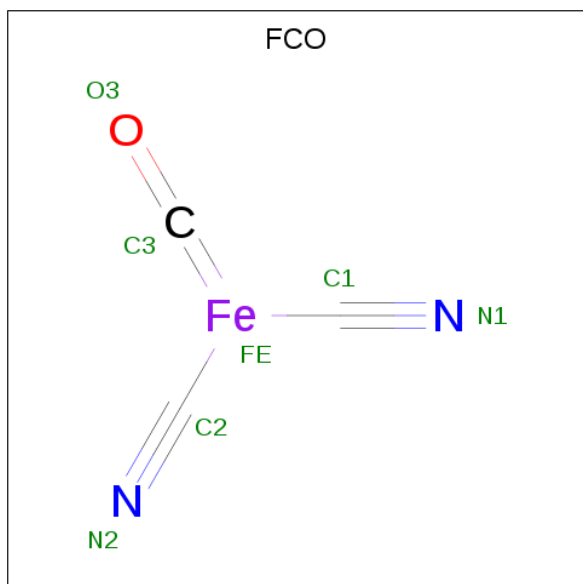
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	S	1	Total	Fe	S	0	0
			8	4	4		
3	S	1	Total	Fe	S	0	0
			8	4	4		
3	T	1	Total	Fe	S	0	0
			8	4	4		
3	T	1	Total	Fe	S	0	0
			8	4	4		

- Molecule 4 is FE3-S4 CLUSTER (three-letter code: F3S) (formula: Fe_3S_4).



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

- Molecule 5 is CARBONMONOXIDE-(DICYANO) IRON (three-letter code: FCO) (formula: $\text{C}_3\text{FeN}_2\text{O}$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	L	1	Total	C	Fe	N	O	0	0
			7	3	1	2	1		

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	M	1	Total	C	Fe	N	O	0	0
			7	3	1	2	1		

- Molecule 6 is NICKEL (II) ION (three-letter code: NI) (formula: Ni).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	L	1	Total	Ni	0	0
			1	1		
6	M	1	Total	Ni	0	0
			1	1		

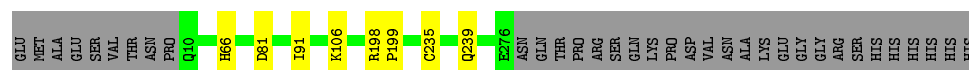
- Molecule 7 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	L	1	Total	Mg	0	0
			1	1		
7	M	1	Total	Mg	0	0
			1	1		

- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	S	178	Total	O	0	0
			178	178		
8	L	397	Total	O	0	0
			397	397		
8	T	145	Total	O	0	0
			145	145		
8	M	346	Total	O	0	0
			346	346		

- Molecule 1: Hydrogenase-2 small chain



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|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| GLU | MET | ALA | GLY | SER | VAL | THR | THR | ASN | PRO | Q10 | T23 | D102 | D212 | G228 | P229 | L251 | E276 | ASN | GLN | THR | THR | PRO | ARG | ARG | SER | SER | GLN | LYS | LYS | ASP | VAL | ASN | ALA | ALA | LYS | LYS | GLY | GLY | ARG | SER | HIS | HIS | HIS | HIS | HIS |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|

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|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| P601 | D613 | C546 | R552 | VAL | ASP | ALA | ASP | GLY | ASN | GLU | VAL | VAL | SER | VAL | LYS | VAL | LEU | MET | S2 | T6 | R12 | I13 | Q14 | D20 | R59 | A69 | I82 | I119 | T120 | K135 | H141 | K150 | R199 | K211 | L218 | Y242 | E271 | K272 | L283 | Y312 | R313 | Y322 | Y375 | I382 | K424 | K428 | V459 | K460 | P461 | E468 | E469 | Y470 |
|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|

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|-----|----|------|----|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Met | S2 | D844 | D8 | H552 | VAL | ASP | ASP | ASP | GLY | ASN | GLU | VAL | VAL | SER | VAL | LYS | VAL | LEU | H172 | G173 | H174 | P175 | R203 | K211 | L283 | F299 | Y312 | R313 | Y322 | D354 | Y375 | P379 | N382 | R383 | R424 | P461 | F469 | V500 | P501 | D513 | F520 |
|-----|----|------|----|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	99.80 Å 100.40 Å 168.71 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	86.28 – 1.60 86.28 – 1.60	Depositor EDS
% Data completeness (in resolution range)	99.9 (86.28-1.60) 99.9 (86.28-1.60)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.20 (at 1.60 Å)	Xtriage
Refinement program	REFMAC 5.8.0218	Depositor
R, R_{free}	0.162 , 0.190 0.175 , 0.199	Depositor DCC
R_{free} test set	10996 reflections (4.94%)	wwPDB-VP
Wilson B-factor (Å ²)	15.0	Xtriage
Anisotropy	0.038	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 47.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.011 for k,h,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	13848	wwPDB-VP
Average B, all atoms (Å ²)	19.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.20% 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: NI, MG, F3S, SF4, FCO

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	0.80	0/2097	0.83	1/2854 (0.0%)
1	T	0.76	0/2097	0.85	3/2855 (0.1%)
2	L	0.86	6/4442 (0.1%)	0.90	9/6055 (0.1%)
2	M	0.81	1/4450 (0.0%)	0.90	12/6065 (0.2%)
All	All	0.82	7/13086 (0.1%)	0.88	25/17829 (0.1%)

The worst 5 of 7 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	L	271[A]	GLU	CD-OE1	-8.94	1.15	1.25
2	L	271[B]	GLU	CD-OE1	-8.94	1.15	1.25
2	L	271[A]	GLU	CD-OE2	-5.72	1.19	1.25
2	L	271[B]	GLU	CD-OE2	-5.72	1.19	1.25
2	L	468	GLU	CD-OE1	-5.56	1.19	1.25

The worst 5 of 25 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	T	102	ASP	CB-CG-OD1	7.53	125.08	118.30
2	M	299	PHE	CB-CG-CD1	7.31	125.92	120.80
2	L	12	ARG	NE-CZ-NH1	7.27	123.94	120.30
2	M	299	PHE	CB-CG-CD2	-7.12	115.81	120.80
2	M	424	ARG	NE-CZ-NH1	6.76	123.68	120.30

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	2037	0	1967	4	0
1	T	2037	0	1960	3	0
2	L	4317	0	4265	15	0
2	M	4327	0	4273	11	0
3	S	16	0	0	0	0
3	T	16	0	0	0	0
4	S	7	0	0	0	0
4	T	7	0	0	0	0
5	L	7	0	0	0	0
5	M	7	0	0	0	0
6	L	1	0	0	0	0
6	M	1	0	0	0	0
7	L	1	0	0	0	0
7	M	1	0	0	0	0
8	L	397	0	0	5	0
8	M	346	0	0	2	0
8	S	178	0	0	1	0
8	T	145	0	0	0	0
All	All	13848	0	12465	32	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 1.

The worst 5 of 32 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:L:459:VAL:HG23	8:L:724:HOH:O	1.82	0.79
2:L:271[A]:GLU:HG2	2:L:272:TRP:CD1	2.31	0.65
2:L:6[B]:THR:CG2	8:L:704:HOH:O	2.45	0.64
2:L:6[A]:THR:HG23	2:L:20:ASP:OD1	1.98	0.62
2:M:80:LEU:HD23	2:M:469[B]:PHE:CE2	2.42	0.55

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	266/301 (88%)	257 (97%)	9 (3%)	0	100	100
1	T	266/301 (88%)	257 (97%)	9 (3%)	0	100	100
2	L	555/567 (98%)	534 (96%)	20 (4%)	1 (0%)	47	26
2	M	555/567 (98%)	532 (96%)	22 (4%)	1 (0%)	47	26
All	All	1642/1736 (95%)	1580 (96%)	60 (4%)	2 (0%)	51	29

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	L	211	LYS
2	M	211	LYS

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	213/242 (88%)	212 (100%)	1 (0%)	88	80
1	T	213/242 (88%)	212 (100%)	1 (0%)	88	80
2	L	471/479 (98%)	465 (99%)	6 (1%)	69	50
2	M	471/479 (98%)	466 (99%)	5 (1%)	73	57
All	All	1368/1442 (95%)	1355 (99%)	13 (1%)	81	61

5 of 13 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	L	382[A]	ASN
2	L	382[B]	ASN
2	M	312	TYR
2	L	312	TYR
2	M	141	HIS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	T	75	GLN
2	M	411	ASN
1	T	89	ASN
2	L	411	ASN
2	M	47	ASN

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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 12 ligands modelled in this entry, 4 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
3	SF4	T	403	1	0,12,12	0.00	-	-		
5	FCO	M	601	2	0,6,6	0.00	-	-		
4	F3S	T	402	1	0,9,9	0.00	-	-		
3	SF4	T	401	1	0,12,12	0.00	-	-		
3	SF4	S	401	1	0,12,12	0.00	-	-		
5	FCO	L	601	2	0,6,6	0.00	-	-		
3	SF4	S	403	1	0,12,12	0.00	-	-		
4	F3S	S	402	1	0,9,9	0.00	-	-		

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	SF4	T	403	1	-	-	0/6/5/5
4	F3S	T	402	1	-	-	0/3/3/3
3	SF4	T	401	1	-	-	0/6/5/5
3	SF4	S	401	1	-	-	0/6/5/5
3	SF4	S	403	1	-	-	0/6/5/5
4	F3S	S	402	1	-	-	0/3/3/3

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 [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	S	267/301 (88%)	-0.59	0 100 100	12, 17, 31, 50	0
1	T	267/301 (88%)	-0.42	0 100 100	13, 21, 34, 49	0
2	L	551/567 (97%)	-0.64	1 (0%) 95 94	10, 15, 29, 38	0
2	M	551/567 (97%)	-0.54	0 100 100	11, 18, 35, 53	0
All	All	1636/1736 (94%)	-0.56	1 (0%) 95 94	10, 17, 33, 53	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	L	469	PHE	2.2

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, 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(Å ²)	Q<0.9
6	NI	M	602	1/1	0.99	0.05	15,15,15,15	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
3	SF4	T	403	8/8	0.99	0.07	13,14,15,15	0
3	SF4	S	401	8/8	0.99	0.05	15,17,17,18	0
6	NI	L	602	1/1	0.99	0.06	12,12,12,12	0
7	MG	M	603	1/1	0.99	0.10	11,11,11,11	0
5	FCO	M	601	7/7	1.00	0.06	10,12,14,14	0
4	F3S	T	402	7/7	1.00	0.04	15,15,16,16	0
5	FCO	L	601	7/7	1.00	0.07	10,10,11,12	0
3	SF4	S	403	8/8	1.00	0.07	11,11,12,12	0
3	SF4	T	401	8/8	1.00	0.04	16,17,17,18	0
4	F3S	S	402	7/7	1.00	0.04	12,13,14,14	0
7	MG	L	603	1/1	1.00	0.10	8,8,8,8	0

6.5 Other polymers [i](#)

There are no such residues in this entry.