



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 07:37 PM UTC

PDB ID : 3UWM / pdb_00003uwm
Title : Ec_IspH in complex with 4-oxobutyl diphosphate (1302)
Authors : Span, I.; Wang, K.; Wang, W.; Zhang, Y.; Bacher, A.; Eisenreich, W.; Schulz, C.; Oldfield, E.; Groll, M.
Deposited on : 2011-12-02
Resolution : 1.80 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)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

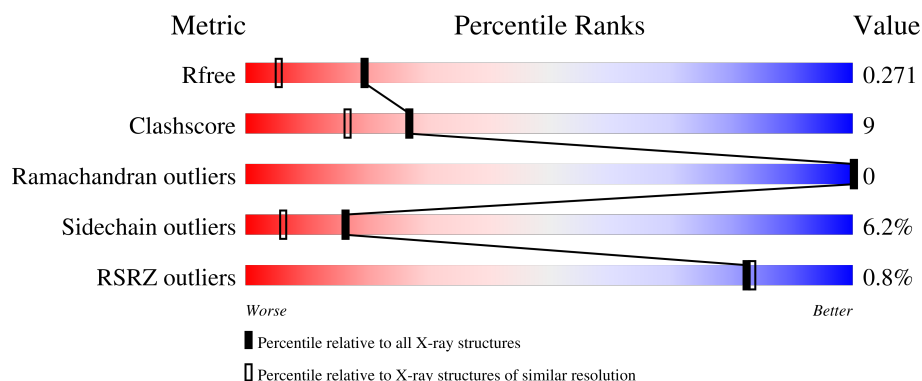
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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))
R_{free}	180053	7662 (1.80-1.80)
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	324	76% 17% • 5%
1	B	324	74% 19% • •

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 5314 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.

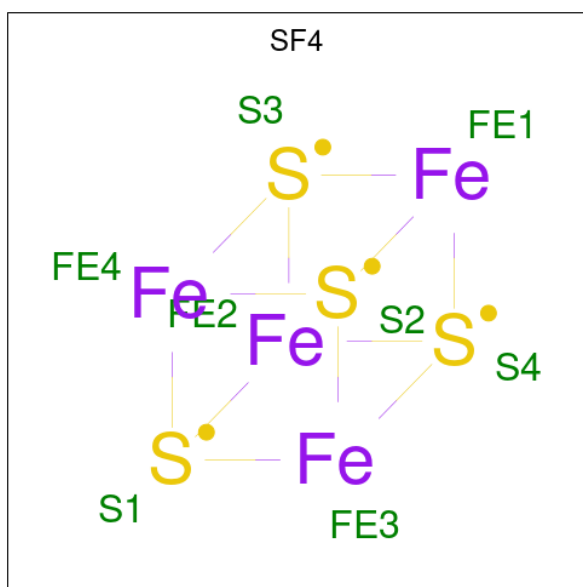
- Molecule 1 is a protein called 4-hydroxy-3-methylbut-2-enyl diphosphate reductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	309	Total	C	N	O	S	0	0	0
			2383	1487	427	459	10			
1	B	310	Total	C	N	O	S	0	0	0
			2390	1492	428	460	10			

There are 16 discrepancies between the modelled and reference sequences:

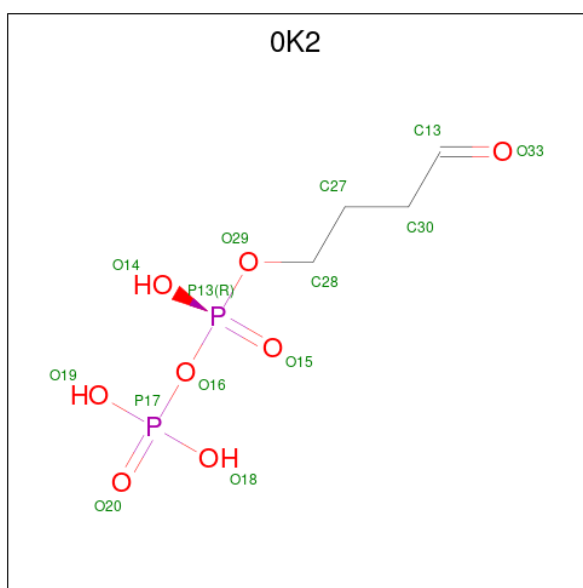
Chain	Residue	Modelled	Actual	Comment	Reference
A	-7	HIS	-	expression tag	UNP P62623
A	-6	HIS	-	expression tag	UNP P62623
A	-5	HIS	-	expression tag	UNP P62623
A	-4	HIS	-	expression tag	UNP P62623
A	-3	HIS	-	expression tag	UNP P62623
A	-2	HIS	-	expression tag	UNP P62623
A	-1	GLY	-	expression tag	UNP P62623
A	0	SER	-	expression tag	UNP P62623
B	-7	HIS	-	expression tag	UNP P62623
B	-6	HIS	-	expression tag	UNP P62623
B	-5	HIS	-	expression tag	UNP P62623
B	-4	HIS	-	expression tag	UNP P62623
B	-3	HIS	-	expression tag	UNP P62623
B	-2	HIS	-	expression tag	UNP P62623
B	-1	GLY	-	expression tag	UNP P62623
B	0	SER	-	expression tag	UNP P62623

- Molecule 2 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe₄S₄).



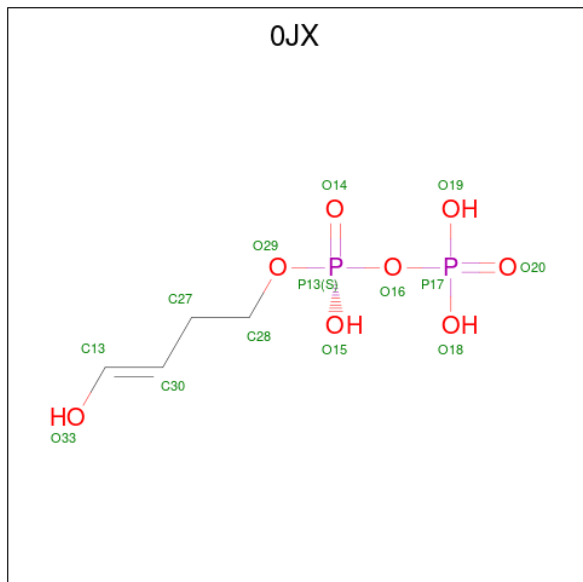
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	Fe	S	0	1
			15	7	8		
2	B	1	Total	Fe	S	0	1
			15	7	8		

- Molecule 3 is 4-oxobutyl trihydrogen diphosphate (CCD ID: 0K2) (formula: $C_4H_{10}O_8P_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	O	P	0	1
			14	4	8	2		
3	B	1	Total	C	O	P	0	1
			14	4	8	2		

- Molecule 4 is (3E)-4-hydroxybut-3-en-1-yl trihydrogen diphosphate (CCD ID: 0JX) (formula: $C_4H_{10}O_8P_2$).



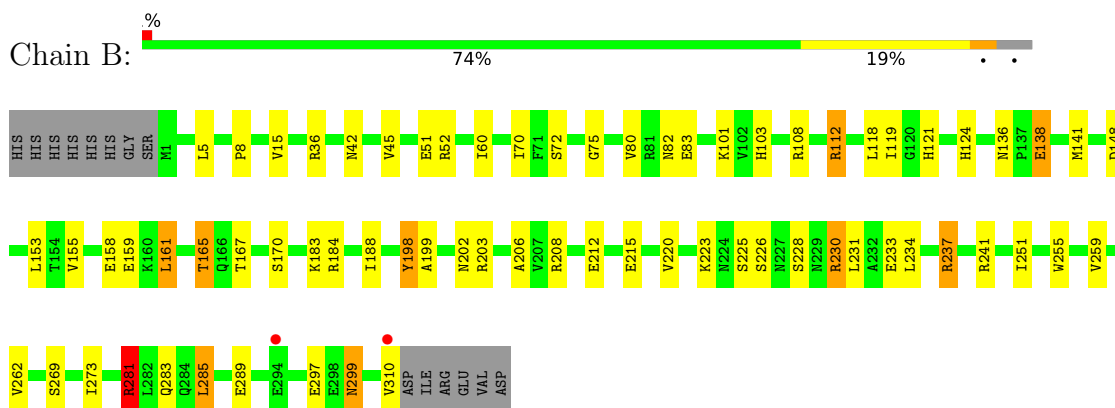
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	O	P	0	1
			14	4	8	2		
4	B	1	Total	C	O	P	0	1
			14	4	8	2		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	223	Total	O	0	0
			223	223		
5	B	232	Total	O	0	0
			232	232		

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- Molecule 1: 4-hydroxy-3-methylbut-2-enyl diphosphate reductase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	70.66Å 80.70Å 111.79Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 1.80 50.00 – 1.80	Depositor EDS
% Data completeness (in resolution range)	99.5 (50.00-1.80) 99.4 (50.00-1.80)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.38 (at 1.79Å)	Xtriage
Refinement program	REFMAC 5.5.0072	Depositor
R, R_{free}	0.185 , 0.268 0.186 , 0.271	Depositor DCC
R_{free} test set	2981 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	17.9	Xtriage
Anisotropy	0.890	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 42.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.52$, $\langle L^2 \rangle = 0.35$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	5314	wwPDB-VP
Average B, all atoms (Å ²)	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 57.32 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 2.4076e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: SF4, 0JX, 0K2

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	1.38	11/2418 (0.5%)	1.29	11/3273 (0.3%)
1	B	1.40	10/2425 (0.4%)	1.27	13/3283 (0.4%)
All	All	1.39	21/4843 (0.4%)	1.28	24/6556 (0.4%)

All (21) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	95	THR	C-O	7.16	1.32	1.23
1	B	220	VAL	C-O	7.08	1.31	1.24
1	A	103	HIS	CE1-NE2	6.57	1.39	1.32
1	A	42	ASN	CA-C	6.15	1.59	1.52
1	A	11	PHE	CA-C	-5.77	1.45	1.52
1	B	198	TYR	C-O	-5.77	1.17	1.24
1	B	167	THR	C-O	-5.61	1.16	1.24
1	B	101	LYS	N-CA	5.58	1.53	1.46
1	B	170	SER	C-O	5.57	1.30	1.23
1	B	183	LYS	N-CA	5.56	1.53	1.46
1	A	74	HIS	CG-ND1	-5.56	1.32	1.38
1	B	269	SER	CA-C	5.47	1.60	1.52
1	B	165	THR	CA-C	5.43	1.59	1.52
1	A	12	CYS	N-CA	-5.33	1.39	1.45
1	A	168	THR	N-CA	5.29	1.52	1.46
1	B	75	GLY	N-CA	5.17	1.50	1.45
1	B	124	HIS	CG-CD2	5.08	1.41	1.35
1	A	119	ILE	N-CA	5.04	1.52	1.46
1	A	124	HIS	CG-CD2	5.03	1.41	1.35
1	A	72	SER	N-CA	5.01	1.52	1.45
1	A	176	ASP	N-CA	5.01	1.52	1.46

All (24) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	230	ARG	NE-CZ-NH1	-10.32	111.18	121.50
1	A	230	ARG	CG-CD-NE	-9.74	90.56	112.00
1	B	230	ARG	CG-CD-NE	-9.63	90.80	112.00
1	A	230	ARG	NE-CZ-NH2	9.05	127.34	119.20
1	B	230	ARG	NE-CZ-NH1	-8.94	112.56	121.50
1	B	237	ARG	NE-CZ-NH2	8.50	126.85	119.20
1	B	230	ARG	NE-CZ-NH2	7.20	125.68	119.20
1	A	131	MET	N-CA-C	-6.77	103.91	111.28
1	B	285	LEU	N-CA-C	-6.70	104.42	112.59
1	B	184	ARG	NE-CZ-NH1	-5.83	115.67	121.50
1	B	72	SER	N-CA-C	5.47	117.14	110.41
1	A	291	ILE	CA-C-N	-5.42	114.01	120.13
1	A	291	ILE	C-N-CA	-5.42	114.01	120.13
1	A	19	ILE	N-CA-C	-5.41	105.25	110.72
1	B	206	ALA	N-CA-C	5.39	117.16	111.28
1	B	237	ARG	CA-CB-CG	-5.35	103.40	114.10
1	A	200	THR	N-CA-C	-5.28	105.44	111.14
1	B	82	ASN	N-CA-C	5.22	117.05	111.36
1	B	70	ILE	N-CA-C	-5.15	100.89	108.11
1	A	208	ARG	NE-CZ-NH2	5.14	123.83	119.20
1	B	281	ARG	NE-CZ-NH1	5.06	126.56	121.50
1	B	237	ARG	NE-CZ-NH1	-5.05	116.45	121.50
1	A	233	GLU	CB-CG-CD	-5.04	104.03	112.60
1	A	82	ASN	N-CA-C	5.04	116.85	111.36

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	2383	0	2395	39	0
1	B	2390	0	2404	50	0
2	A	15	0	0	0	0
2	B	15	0	0	0	0
3	A	14	0	9	0	0
3	B	14	0	10	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	A	14	0	8	0	0
4	B	14	0	7	1	0
5	A	223	0	0	12	0
5	B	232	0	0	22	0
All	All	5314	0	4833	89	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 (89) 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:B:121:HIS:HD2	5:B:658:HOH:O	1.37	1.04
1:B:237:ARG:HD2	5:B:707:HOH:O	1.60	1.02
1:B:203:ARG:CG	5:B:729:HOH:O	2.06	1.01
1:B:112:ARG:HG3	1:B:112:ARG:HH21	1.30	0.95
1:A:276:GLN:HG2	5:A:708:HOH:O	1.64	0.94
1:A:253:GLU:HG3	5:A:688:HOH:O	1.70	0.90
1:B:203:ARG:HB3	5:B:729:HOH:O	1.73	0.89
1:A:309:ARG:HG2	1:A:309:ARG:HH21	1.39	0.87
1:B:203:ARG:CB	5:B:729:HOH:O	2.20	0.86
1:B:203:ARG:HD3	5:B:729:HOH:O	1.79	0.82
1:B:203:ARG:CD	5:B:729:HOH:O	2.28	0.81
1:A:308:LEU:O	1:A:309:ARG:HB2	1.82	0.80
1:B:42:ASN:HD22	1:B:45:VAL:H	1.30	0.79
1:A:103:HIS:HD2	5:A:594:HOH:O	1.66	0.77
1:B:226:SER:OG	5:B:658:HOH:O	2.02	0.75
1:A:161:LEU:HD13	1:A:188:ILE:HD12	1.69	0.73
1:B:297:GLU:HG3	5:B:606:HOH:O	1.89	0.72
1:B:158:GLU:OE1	5:B:680:HOH:O	2.08	0.71
1:B:83:GLU:OE2	5:B:598:HOH:O	2.09	0.70
1:B:233:GLU:OE2	5:B:581:HOH:O	2.10	0.70
1:B:36:ARG:HG2	1:B:36:ARG:HH21	1.57	0.69
1:A:36:ARG:HH21	1:A:36:ARG:HG2	1.60	0.67
1:A:36:ARG:HG2	1:A:36:ARG:NH2	2.09	0.65
1:B:103:HIS:HD2	5:B:560:HOH:O	1.79	0.65
1:B:60:ILE:HD11	1:B:80:VAL:HG13	1.79	0.65
1:A:42:ASN:HD22	1:A:45:VAL:H	1.43	0.64
1:B:237:ARG:CD	5:B:707:HOH:O	2.29	0.63
1:A:4:LEU:HD22	1:A:261:CYS:SG	2.39	0.61
1:B:36:ARG:HG2	1:B:36:ARG:NH2	2.14	0.61

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:125:PRO:HB2	5:A:717:HOH:O	2.02	0.59
1:B:241:ARG:NH1	1:B:255:TRP:O	2.37	0.58
1:A:125:PRO:CB	5:A:717:HOH:O	2.52	0.57
1:B:203:ARG:HG2	5:B:729:HOH:O	1.87	0.57
1:B:112:ARG:HH21	1:B:112:ARG:CG	2.11	0.56
1:A:8:PRO:HG2	1:A:202:ASN:HB3	1.88	0.55
1:A:112:ARG:HB3	1:A:114:GLU:HG3	1.88	0.55
1:B:136:ASN:C	1:B:136:ASN:HD22	2.15	0.55
1:A:236:GLN:HG3	1:A:242:ALA:HB3	1.89	0.55
1:A:36:ARG:HB3	5:A:676:HOH:O	2.08	0.54
1:A:59:GLN:HB3	5:A:595:HOH:O	2.07	0.54
1:A:60:ILE:HD12	1:A:69:LEU:HD11	1.89	0.54
1:A:57:ILE:HD12	1:A:63:VAL:HG22	1.92	0.52
1:A:187:LYS:HE2	5:B:730:HOH:O	2.08	0.52
1:B:42:ASN:ND2	1:B:45:VAL:H	2.05	0.52
1:A:108:ARG:HB2	1:A:108:ARG:CZ	2.41	0.51
1:A:108:ARG:HB2	1:A:108:ARG:NH1	2.26	0.51
1:A:1:MET:N	5:A:588:HOH:O	2.43	0.51
1:A:309:ARG:HG2	1:A:309:ARG:NH2	2.15	0.51
1:B:310:VAL:HG12	1:B:310:VAL:O	2.10	0.50
1:A:135:SER:O	1:A:137:PRO:HD3	2.11	0.50
1:B:136:ASN:ND2	1:B:138:GLU:H	2.09	0.50
1:B:15:VAL:CG2	4:B:403[B]:0JX:H5	2.41	0.50
1:A:111:ARG:HG3	5:A:657:HOH:O	2.12	0.49
1:A:208:ARG:NH1	5:A:622:HOH:O	2.19	0.49
1:B:299:ASN:HD22	1:B:299:ASN:C	2.21	0.49
1:B:60:ILE:CD1	1:B:80:VAL:HG13	2.43	0.48
1:B:234:LEU:C	1:B:234:LEU:HD23	2.39	0.48
1:B:108:ARG:HB2	1:B:108:ARG:CZ	2.44	0.47
1:B:203:ARG:HH21	1:B:203:ARG:HG3	1.78	0.47
1:B:121:HIS:CD2	5:B:658:HOH:O	2.28	0.47
1:A:36:ARG:HH21	1:A:36:ARG:CG	2.27	0.47
1:A:297:GLU:HG3	5:B:569:HOH:O	2.15	0.47
1:B:161:LEU:HD13	1:B:188:ILE:HD12	1.97	0.47
1:A:120:GLY:O	1:A:145:GLU:HG2	2.15	0.47
1:B:8:PRO:HG2	1:B:202:ASN:HB3	1.98	0.46
1:A:309:ARG:NH2	1:A:309:ARG:CG	2.75	0.46
1:A:42:ASN:HD21	1:A:44:TYR:HB3	1.81	0.46
1:A:103:HIS:HE1	5:A:503:HOH:O	1.99	0.46
1:B:203:ARG:HG3	1:B:203:ARG:NH2	2.32	0.45
1:B:234:LEU:HD23	1:B:234:LEU:O	2.17	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:231:LEU:HD11	5:B:729:HOH:O	2.16	0.44
1:A:133:GLN:NE2	5:A:580:HOH:O	2.50	0.44
1:A:112:ARG:CB	1:A:114:GLU:HG3	2.48	0.44
1:B:223:LYS:HE2	5:B:698:HOH:O	2.17	0.43
1:B:51:GLU:OE2	1:B:52:ARG:HD2	2.18	0.43
1:B:251:ILE:HD12	1:B:281:ARG:HG2	2.00	0.43
1:A:57:ILE:HD12	1:A:63:VAL:CG2	2.49	0.42
1:B:118:LEU:HB2	1:B:141:MET:CE	2.49	0.42
1:B:283:GLN:NE2	5:B:653:HOH:O	2.41	0.42
1:B:198:TYR:CG	1:B:199:ALA:N	2.88	0.41
1:A:70:ILE:HA	1:A:92:PHE:O	2.20	0.41
1:B:119:ILE:HD12	1:B:165:THR:HG22	2.02	0.41
1:B:103:HIS:HE1	5:B:506:HOH:O	2.02	0.41
1:B:215:GLU:HB2	1:B:259:VAL:HG13	2.03	0.41
1:B:208:ARG:O	1:B:212:GLU:HG3	2.21	0.41
1:B:136:ASN:HD22	1:B:138:GLU:H	1.68	0.40
1:B:225:SER:HB3	1:B:228:SER:HB2	2.03	0.40
1:A:108:ARG:HD3	1:A:112:ARG:NH1	2.37	0.40
1:A:230:ARG:HD3	1:A:230:ARG:HA	1.88	0.40

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	A	307/324 (95%)	302 (98%)	5 (2%)	0	100	100
1	B	308/324 (95%)	305 (99%)	3 (1%)	0	100	100
All	All	615/648 (95%)	607 (99%)	8 (1%)	0	100	100

There are no Ramachandran outliers to report.

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	257/271 (95%)	240 (93%)	17 (7%)	15	5
1	B	258/271 (95%)	243 (94%)	15 (6%)	18	7
All	All	515/542 (95%)	483 (94%)	32 (6%)	16	6

All (32) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	4	LEU
1	A	5	LEU
1	A	7	ASN
1	A	57	ILE
1	A	68	ILE
1	A	69	LEU
1	A	97	PRO
1	A	138	GLU
1	A	153	LEU
1	A	161	LEU
1	A	187	LYS
1	A	230	ARG
1	A	257	LYS
1	A	278	VAL
1	A	294	GLU
1	A	307	GLU
1	A	309	ARG
1	B	5	LEU
1	B	112	ARG
1	B	138	GLU
1	B	148	ASP
1	B	153	LEU
1	B	155	VAL
1	B	159	GLU
1	B	161	LEU
1	B	230	ARG
1	B	262	VAL

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Mol	Chain	Res	Type
1	B	273	ILE
1	B	281	ARG
1	B	285	LEU
1	B	289	GLU
1	B	299	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (19) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	2	GLN
1	A	42	ASN
1	A	103	HIS
1	A	121	HIS
1	A	133	GLN
1	A	136	ASN
1	A	213	GLN
1	A	236	GLN
1	A	252	GLN
1	A	277	ASN
1	B	42	ASN
1	B	59	GLN
1	B	103	HIS
1	B	133	GLN
1	B	136	ASN
1	B	213	GLN
1	B	277	ASN
1	B	283	GLN
1	B	299	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 ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry

8 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	B	401[A]	1	0,9,12	-	-	-		
4	OJX	B	403[B]	2	12,13,13	1.93	4 (33%)	15,18,18	1.89	4 (26%)
2	SF4	A	401[A]	1	0,9,12	-	-	-		
2	SF4	B	401[B]	1,4	0,12,12	-	-	-		
3	OK2	A	402[A]	-	11,13,13	1.84	4 (36%)	15,18,18	1.80	4 (26%)
3	OK2	B	402[A]	-	11,13,13	1.85	3 (27%)	15,18,18	1.23	0
4	OJX	A	403[B]	2	12,13,13	1.76	3 (25%)	15,18,18	2.00	5 (33%)
2	SF4	A	401[B]	1,4	0,12,12	-	-	-		

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
2	SF4	B	401[A]	1	-	-	0/3/3/5
4	OJX	B	403[B]	2	-	2/12/13/13	-
2	SF4	A	401[A]	1	-	-	0/3/3/5
2	SF4	B	401[B]	1,4	-	-	0/6/5/5
3	OK2	A	402[A]	-	-	2/13/13/13	-
3	OK2	B	402[A]	-	-	2/13/13/13	-
4	OJX	A	403[B]	2	-	2/12/13/13	-
2	SF4	A	401[B]	1,4	-	-	0/6/5/5

All (14) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	402[A]	OK2	P13-O16	4.24	1.64	1.59
3	B	402[A]	OK2	P13-O16	4.19	1.64	1.59

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	403[B]	0JX	P13-O16	3.78	1.63	1.59
4	B	403[B]	0JX	P13-O16	3.67	1.63	1.59
3	B	402[A]	0K2	O33-C13	3.28	1.38	1.20
4	B	403[B]	0JX	P17-O19	-3.06	1.43	1.54
3	A	402[A]	0K2	P17-O19	-2.69	1.44	1.54
4	A	403[B]	0JX	P17-O19	-2.58	1.45	1.54
4	B	403[B]	0JX	P13-O15	-2.54	1.43	1.55
4	B	403[B]	0JX	P13-O14	2.38	1.59	1.50
3	A	402[A]	0K2	O33-C13	2.32	1.33	1.20
4	A	403[B]	0JX	P13-O14	2.14	1.58	1.50
3	B	402[A]	0K2	P13-O15	-2.07	1.43	1.50
3	A	402[A]	0K2	P17-O18	2.01	1.62	1.54

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	B	403[B]	0JX	O19-P17-O16	4.79	120.71	104.64
4	A	403[B]	0JX	O15-P13-O16	4.14	118.47	107.27
3	A	402[A]	0K2	O19-P17-O16	3.28	115.64	104.64
4	A	403[B]	0JX	O19-P17-O16	3.21	115.40	104.64
4	B	403[B]	0JX	O16-P13-O14	-3.07	101.47	110.70
4	A	403[B]	0JX	O16-P13-O14	-2.93	101.88	110.70
4	A	403[B]	0JX	O29-C28-C27	2.85	119.45	108.98
3	A	402[A]	0K2	O16-P13-O15	2.82	119.19	110.70
4	B	403[B]	0JX	O15-P13-O16	2.79	114.82	107.27
3	A	402[A]	0K2	O16-P17-O20	-2.72	96.71	111.04
3	A	402[A]	0K2	O29-C28-C27	2.71	118.88	109.28
4	A	403[B]	0JX	O16-P17-O20	-2.39	98.45	111.04
4	B	403[B]	0JX	O16-P17-O20	-2.17	99.62	111.04

There are no chirality outliers.

All (8) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	402[A]	0K2	O33-C13-C30-C27
3	B	402[A]	0K2	C27-C28-O29-P13
3	B	402[A]	0K2	O33-C13-C30-C27
4	A	403[B]	0JX	C27-C28-O29-P13
4	B	403[B]	0JX	C27-C28-O29-P13
3	A	402[A]	0K2	C27-C28-O29-P13
4	A	403[B]	0JX	C28-C27-C30-C13
4	B	403[B]	0JX	C28-C27-C30-C13

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	B	403[B]	0JX	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 [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	309/324 (95%)	-0.03	3 (0%) 79 80	12, 23, 44, 64	0
1	B	310/324 (95%)	0.02	2 (0%) 85 86	12, 24, 44, 73	0
All	All	619/648 (95%)	-0.01	5 (0%) 82 83	12, 24, 45, 73	0

All (5) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	310	VAL	3.8
1	A	86	SER	2.2
1	A	67	ALA	2.2
1	B	294	GLU	2.1
1	A	88	ASP	2.1

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
3	OK2	A	402[A]	14/14	0.75	0.12	15,18,23,28	14
2	SF4	B	401[A]	7/8	0.88	0.11	14,15,16,17	7
2	SF4	B	401[B]	8/8	0.88	0.11	13,15,17,46	8
2	SF4	A	401[A]	7/8	0.89	0.11	12,14,16,18	7
2	SF4	A	401[B]	8/8	0.89	0.11	12,15,19,44	8
3	OK2	B	402[A]	14/14	0.89	0.10	15,17,26,30	14
4	OJX	A	403[B]	14/14	0.97	0.06	15,18,26,28	14
4	OJX	B	403[B]	14/14	0.98	0.06	14,17,24,29	14

6.5 Other polymers [i](#)

There are no such residues in this entry.