



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 12:46 AM GMT

PDB ID : 2BKL
Title : STRUCTURAL AND MECHANISTIC ANALYSIS OF TWO PROLYL ENDOPEPTIDASES: ROLE OF INTER-DOMAIN DYNAMICS IN CATALYSIS AND SPECIFICITY
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Deposited on : 2005-02-16
Resolution : 1.50 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
<http://wwpdb.org/validation/2016/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 : 1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20026688
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : trunk26865

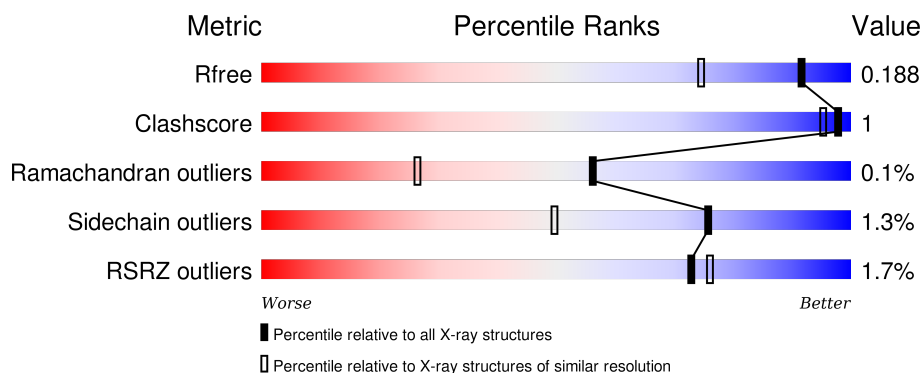
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

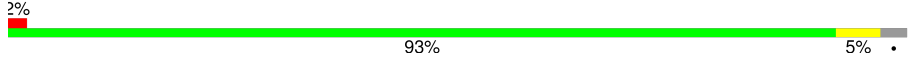
The reported resolution of this entry is 1.50 Å.

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))
R_{free}	91344	2072 (1.50-1.50)
Clashscore	102246	2274 (1.50-1.50)
Ramachandran outliers	100387	2218 (1.50-1.50)
Sidechain outliers	100360	2216 (1.50-1.50)
RSRZ outliers	91569	2075 (1.50-1.50)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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	695	
1	B	695	

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	ZAH	A	1533	-	-	-	X
3	MES	A	1678	-	-	-	X
3	MES	A	1679	-	-	-	X

2 Entry composition [i](#)

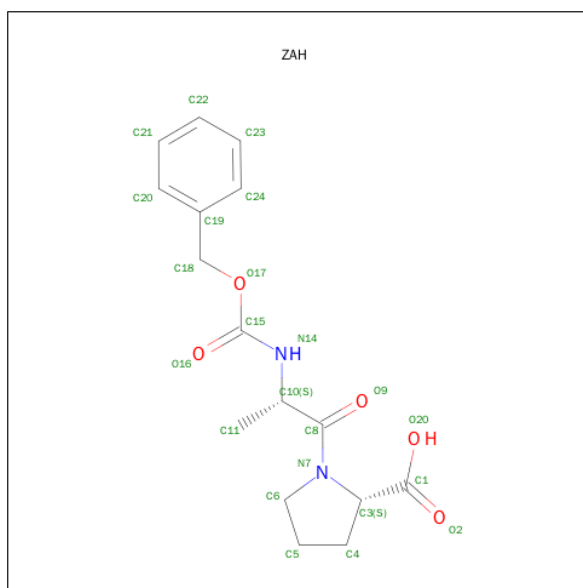
There are 5 unique types of molecules in this entry. The entry contains 12202 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 PROLYL ENDOPEPTIDASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	677	Total	C	N	O	S	0	2	1
			5357	3418	927	999	13			
1	B	678	Total	C	N	O	S	0	2	1
			5366	3423	929	1001	13			

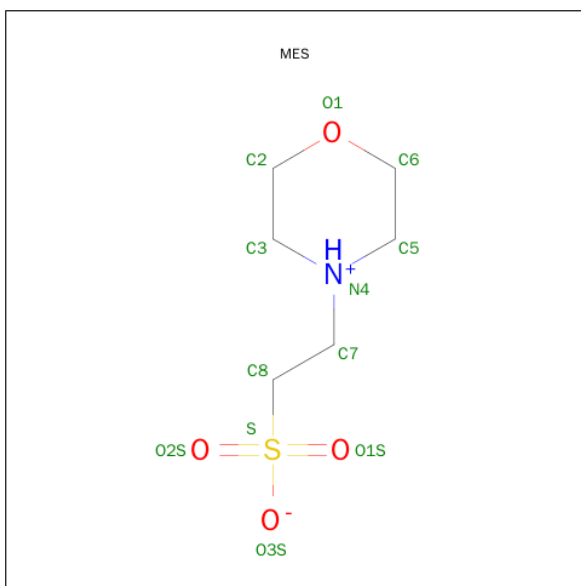
- Molecule 2 is N-[(BENZYLOXY)CARBONYL]-L-ALANYL-L-PROLINE (three-letter code: ZAH) (formula: C₁₆H₂₀N₂O₅).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			22	16	2	4		
2	B	1	Total	C	N	O	0	0
			22	16	2	4		
2	B	1	Total	C	N	O	0	0
			23	16	2	5		

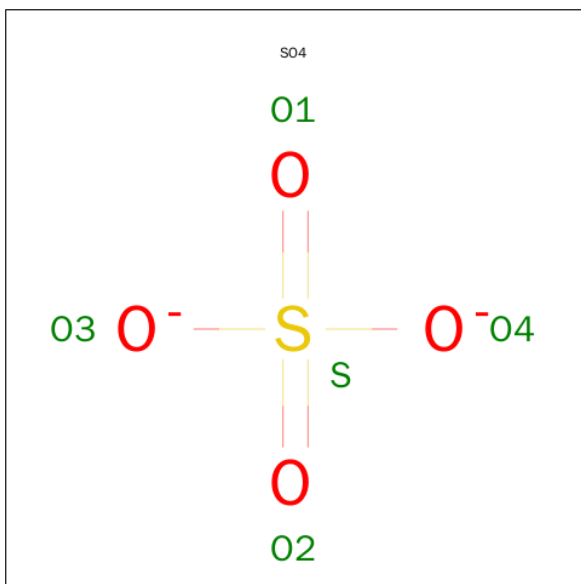
- Molecule 3 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (three-letter code: MES)

(formula: C₆H₁₃NO₄S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	S	0	0
			12	6	1	4	1		
3	A	1	Total	C	N	O	S	0	0
			12	6	1	4	1		
3	B	1	Total	C	N	O	S	0	0
			12	6	1	4	1		

- Molecule 4 is SULFATE ION (three-letter code: SO₄) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	O	S	0	0
			5	4	1		

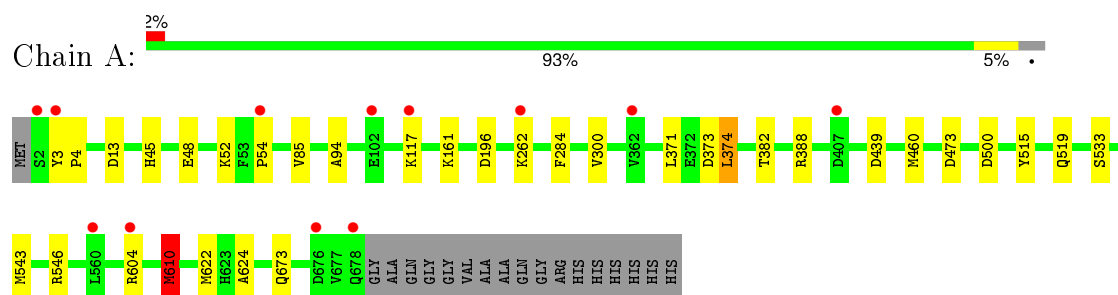
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	676	Total	O	0	0
			676	676		
5	B	695	Total	O	0	0
			695	695		

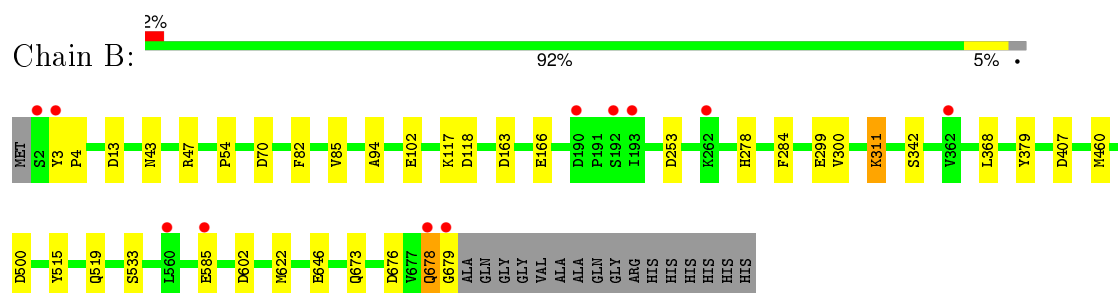
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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. A red dot above a residue indicates a poor fit to the electron density ($\text{RSRZ} > 2$). 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.

• Molecule 1: PROLYL ENDOPEPTIDASE



• Molecule 1: PROLYL ENDOPEPTIDASE



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	65.69 Å 114.72 Å 99.28 Å 90.00° 103.60° 90.00°	Depositor
Resolution (Å)	30.00 – 1.50 29.98 – 1.50	Depositor EDS
% Data completeness (in resolution range)	98.9 (30.00-1.50) 98.9 (29.98-1.50)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.67 (at 1.50 Å)	Xtriage
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.160 , 0.182 0.168 , 0.188	Depositor DCC
R_{free} test set	11252 reflections (5.26%)	DCC
Wilson B-factor (Å ²)	13.8	Xtriage
Anisotropy	0.025	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 42.0	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Outliers	0 of 225309 reflections	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	12202	wwPDB-VP
Average B, all atoms (Å ²)	12.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.57% 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, 0.375 respectively for untwinned datasets, and 0.333, 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: SO4, MES, ZAH

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	0.63	2/5519 (0.0%)	0.81	10/7503 (0.1%)
1	B	0.63	2/5528 (0.0%)	0.82	7/7515 (0.1%)
All	All	0.63	4/11047 (0.0%)	0.81	17/15018 (0.1%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	460	MET	SD-CE	-8.90	1.27	1.77
1	B	460	MET	SD-CE	-8.33	1.31	1.77
1	A	533	SER	C-O	7.82	1.38	1.23
1	B	533	SER	C-O	6.43	1.35	1.23

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	546	ARG	NE-CZ-NH1	7.26	123.93	120.30
1	A	196	ASP	CB-CG-OD2	6.75	124.38	118.30
1	A	500	ASP	CB-CG-OD2	6.26	123.93	118.30
1	A	610[A]	MET	CA-CB-CG	6.08	123.64	113.30
1	A	610[B]	MET	CA-CB-CG	6.08	123.64	113.30
1	A	473	ASP	CB-CG-OD2	5.97	123.67	118.30
1	B	253	ASP	CB-CG-OD2	5.79	123.51	118.30
1	B	163	ASP	CB-CG-OD2	5.74	123.47	118.30
1	B	13	ASP	CB-CG-OD2	5.59	123.34	118.30
1	A	13	ASP	CB-CG-OD2	5.53	123.27	118.30
1	A	373	ASP	CB-CG-OD2	5.48	123.23	118.30
1	A	543	MET	CG-SD-CE	5.38	108.81	100.20
1	B	118	ASP	CB-CG-OD1	5.35	123.11	118.30
1	B	500	ASP	CB-CG-OD2	5.31	123.08	118.30
1	B	602	ASP	CB-CG-OD2	5.22	123.00	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	676	ASP	CB-CG-OD2	5.16	122.95	118.30
1	A	439	ASP	CB-CG-OD1	5.09	122.88	118.30

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	A	5357	0	5208	10	0
1	B	5366	0	5216	14	0
2	A	22	0	19	0	0
2	B	45	0	38	0	0
3	A	24	0	24	0	0
3	B	12	0	12	0	0
4	A	5	0	0	0	0
5	A	676	0	0	0	0
5	B	695	0	0	4	0
All	All	12202	0	10517	24	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.

All (24) 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:3:TYR:HB3	1:A:4:PRO:HD3	1.79	0.63
1:A:3:TYR:HB2	1:A:45:HIS:CE1	2.33	0.63
1:B:678:GLN:HG2	1:B:679:GLY:N	2.17	0.58
1:A:3:TYR:HB2	1:A:45:HIS:ND1	2.21	0.56
1:B:3:TYR:HB3	1:B:4:PRO:HD3	1.88	0.55
1:A:515:TYR:CZ	1:A:519:GLN:HG3	2.44	0.52
1:B:515:TYR:CZ	1:B:519:GLN:HG3	2.47	0.50
1:B:54:PRO:HD3	1:B:673:GLN:HE21	1.76	0.50
1:B:70:ASP:OD1	5:B:2129:HOH:O	2.20	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:371:LEU:HD12	1:A:374:LEU:HD22	1.95	0.48
1:A:382:THR:HG22	1:A:388:ARG:HA	1.96	0.47
1:B:82:PHE:CZ	1:B:102:GLU:HG3	2.49	0.47
1:A:85:VAL:CG1	1:A:94:ALA:HB1	2.44	0.47
1:B:284:PHE:HB2	1:B:300:VAL:HB	1.95	0.47
1:A:610[B]:MET:HG3	1:A:624:ALA:HB1	1.96	0.46
1:B:85:VAL:CG1	1:B:94:ALA:HB1	2.46	0.46
1:B:299:GLU:OE1	1:B:311:LYS:NZ	2.44	0.46
1:A:284:PHE:HB2	1:A:300:VAL:HB	1.98	0.45
1:B:646:GLU:OE2	5:B:2667:HOH:O	2.20	0.44
1:A:54:PRO:HD3	1:A:673:GLN:HE21	1.84	0.43
1:B:368:LEU:HD23	1:B:379:TYR:HB3	2.00	0.42
1:B:278:HIS:CD2	5:B:2375:HOH:O	2.74	0.41
1:B:43:ASN:O	1:B:47:ARG:HG2	2.20	0.41
1:B:166:GLU:O	5:B:2253:HOH:O	2.21	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	677/695 (97%)	664 (98%)	13 (2%)	0	100	100
1	B	678/695 (98%)	663 (98%)	14 (2%)	1 (0%)	56	26
All	All	1355/1390 (98%)	1327 (98%)	27 (2%)	1 (0%)	56	26

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	678	GLN

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	559/570 (98%)	549 (98%)	10 (2%)	66	35
1	B	560/570 (98%)	554 (99%)	6 (1%)	80	58
All	All	1119/1140 (98%)	1103 (99%)	16 (1%)	76	47

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	48	GLU
1	A	52	LYS
1	A	117	LYS
1	A	161	LYS
1	A	262	LYS
1	A	374	LEU
1	A	604	ARG
1	A	610[A]	MET
1	A	610[B]	MET
1	A	622	MET
1	B	117	LYS
1	B	311	LYS
1	B	342	SER
1	B	407	ASP
1	B	585	GLU
1	B	622	MET

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	463	ASN
1	A	673	GLN
1	B	278	HIS
1	B	416	GLN
1	B	673	GLN

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 carbohydrates in this entry.

5.6 Ligand geometry ⓘ

7 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	ZAH	A	1533	1	21,23,24	2.21	4 (19%)	27,30,32	1.43	5 (18%)
3	MES	A	1678	-	11,12,12	0.70	0	14,16,16	1.84	2 (14%)
3	MES	A	1679	-	11,12,12	0.67	0	14,16,16	2.02	3 (21%)
4	SO4	A	1680	-	4,4,4	0.39	0	6,6,6	0.64	0
2	ZAH	B	1533	1	21,23,24	2.17	4 (19%)	27,30,32	1.12	3 (11%)
2	ZAH	B	1679	-	21,24,24	1.30	1 (4%)	26,32,32	1.30	3 (11%)
3	MES	B	1680	-	11,12,12	0.74	0	14,16,16	1.77	3 (21%)

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	ZAH	A	1533	1	-	0/17/29/31	0/2/2/2
3	MES	A	1678	-	-	0/6/14/14	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	MES	A	1679	-	-	0/6/14/14	0/1/1/1
4	SO4	A	1680	-	-	0/0/0/0	0/0/0/0
2	ZAH	B	1533	1	-	0/17/29/31	0/2/2/2
2	ZAH	B	1679	-	-	0/17/31/31	0/2/2/2
3	MES	B	1680	-	-	0/6/14/14	0/1/1/1

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1533	ZAH	O17-C15	2.96	1.41	1.35
2	A	1533	ZAH	O17-C15	4.23	1.43	1.35
2	B	1533	ZAH	O2-C1	4.52	1.40	1.19
2	B	1533	ZAH	O16-C15	4.60	1.30	1.21
2	A	1533	ZAH	O2-C1	4.67	1.41	1.19
2	A	1533	ZAH	O16-C15	4.90	1.31	1.21
2	B	1679	ZAH	O17-C15	5.48	1.46	1.35
2	A	1533	ZAH	O9-C8	5.55	1.32	1.22
2	B	1533	ZAH	O9-C8	6.26	1.33	1.22

All (19) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1533	ZAH	C11-C10-C8	-3.36	103.82	109.77
2	B	1533	ZAH	C11-C10-C8	-2.24	105.81	109.77
2	A	1533	ZAH	C4-C3-N7	-2.19	99.62	101.89
2	B	1679	ZAH	O17-C15-O16	-2.09	119.92	124.22
2	A	1533	ZAH	O9-C8-N7	-2.08	117.83	121.41
3	A	1678	MES	C7-N4-C3	2.10	116.66	111.27
2	B	1533	ZAH	C10-C8-N7	2.20	121.24	117.90
3	B	1680	MES	C7-N4-C5	2.29	117.14	111.27
2	A	1533	ZAH	C10-C8-N7	2.60	121.84	117.90
3	B	1680	MES	O1S-S-C8	2.64	109.16	106.91
3	A	1679	MES	O2S-S-C8	2.70	109.21	106.91
2	B	1533	ZAH	O17-C15-N14	2.70	116.53	110.54
2	B	1679	ZAH	O17-C15-N14	3.21	117.65	110.54
2	A	1533	ZAH	O17-C15-N14	3.40	118.09	110.54
2	B	1679	ZAH	C18-O17-C15	3.45	124.13	115.91
3	A	1679	MES	O1S-S-C8	3.74	110.10	106.91
3	A	1679	MES	C5-N4-C3	4.53	118.71	108.90
3	B	1680	MES	C5-N4-C3	4.60	118.87	108.90
3	A	1678	MES	C5-N4-C3	4.90	119.50	108.90

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

There are no such residues in this entry.

5.8 Polymer linkage issues

There are no chain breaks in this entry.

6 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

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	677/695 (97%)	-0.06	12 (1%) 71 75	4, 10, 20, 37	0
1	B	678/695 (97%)	-0.05	11 (1%) 74 78	4, 10, 20, 38	0
All	All	1355/1390 (97%)	-0.06	23 (1%) 73 76	4, 10, 20, 38	0

All (23) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	679	GLY	12.9
1	B	3	TYR	10.3
1	A	3	TYR	8.8
1	B	192	SER	3.9
1	B	262	LYS	3.7
1	A	117	LYS	3.4
1	A	54	PRO	3.1
1	B	193	ILE	3.1
1	A	102	GLU	2.8
1	A	604	ARG	2.8
1	B	190	ASP	2.7
1	A	407	ASP	2.6
1	B	678	GLN	2.6
1	B	2	SER	2.5
1	A	560	LEU	2.5
1	A	262	LYS	2.5
1	A	2	SER	2.5
1	B	560	LEU	2.2
1	A	678	GLN	2.2
1	A	362	VAL	2.1
1	A	676	ASP	2.1
1	B	362	VAL	2.1
1	B	585	GLU	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 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(\AA^2)	Q<0.9
3	MES	A	1679	12/12	0.94	0.21	4.73	35,38,42,42	0
3	MES	A	1678	12/12	0.94	0.17	2.28	16,23,29,30	0
2	ZAH	A	1533	22/23	0.91	0.13	2.22	9,12,27,28	0
2	ZAH	B	1679	23/23	0.81	0.16	1.81	21,24,30,33	0
2	ZAH	B	1533	22/23	0.93	0.11	1.30	7,10,27,28	0
3	MES	B	1680	12/12	0.95	0.11	1.14	15,19,27,28	0
4	SO4	A	1680	5/5	0.97	0.09	-	25,26,29,31	0

6.5 Other polymers [i](#)

There are no such residues in this entry.