Full wwPDB X-ray Structure Validation Report (i)

Aug 6, 2023 – 09:50 PM EDT

PDB ID	:	1KIZ
Title	:	D100E trichodiene synthase complexed with pyrophosphate
Authors	:	Rynkiewicz, M.J.; Cane, D.E.; Christianson, D.W.
Deposited on	:	2001-12-03
Resolution	:	2.60 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 (i) 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 (i)) were used in the production of this report:

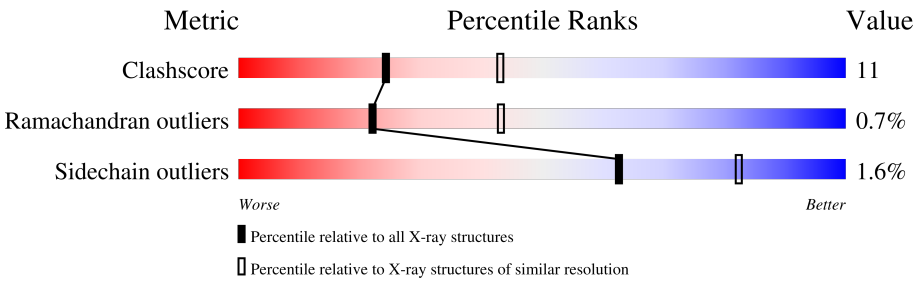
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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))
Clashscore	141614	3518 (2.60-2.60)
Ramachandran outliers	138981	3455 (2.60-2.60)
Sidechain outliers	138945	3455 (2.60-2.60)

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 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 <=5%

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	374	74% 21% 5%
1	B	374	72% 22% • 5%

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 6135 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.

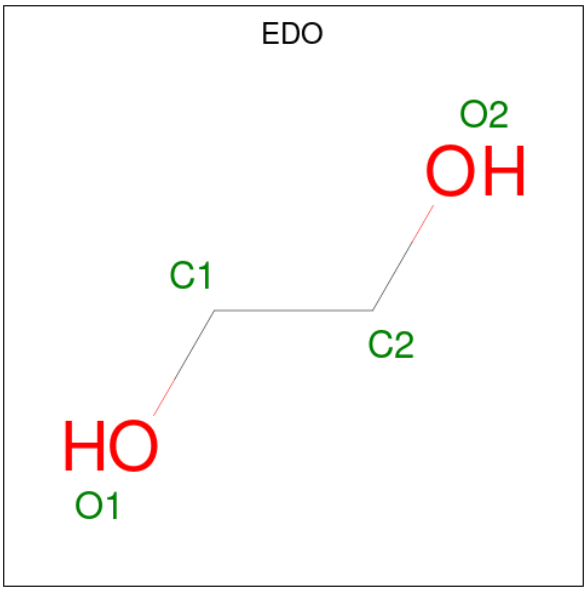
- Molecule 1 is a protein called trichodiene synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	354	2941	1883	493	547	18	0	0	0
1	B	354	2941	1883	493	547	18	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	100	GLU	ASP	engineered mutation	UNP P13513
B	100	GLU	ASP	engineered mutation	UNP P13513

- Molecule 2 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
2	A	1	4	2	2	0	0

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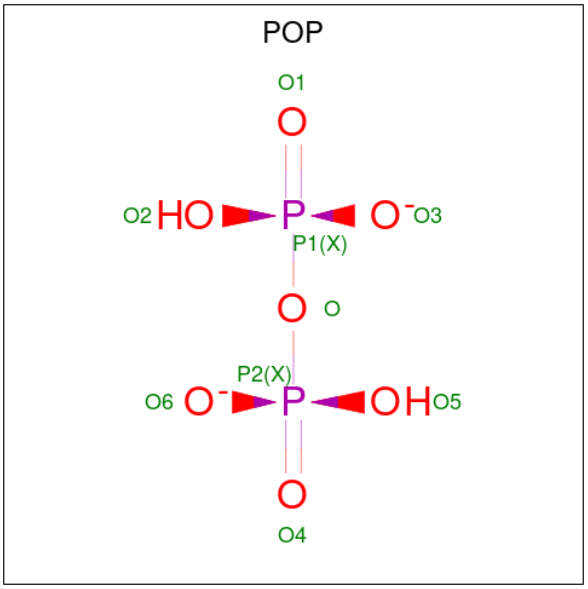
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C O 4 2 2	0	0
2	B	1	Total C O 4 2 2	0	0
2	B	1	Total C O 4 2 2	0	0

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	B	2	Total Mg 2 2	0	0

- Molecule 4 is PYROPHOSPHATE 2- (three-letter code: POP) (formula: $H_2O_7P_2$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	B	1	Total O P 9 7 2	0	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	129	Total O 129 129	0	0
5	B	97	Total O 97 97	0	0

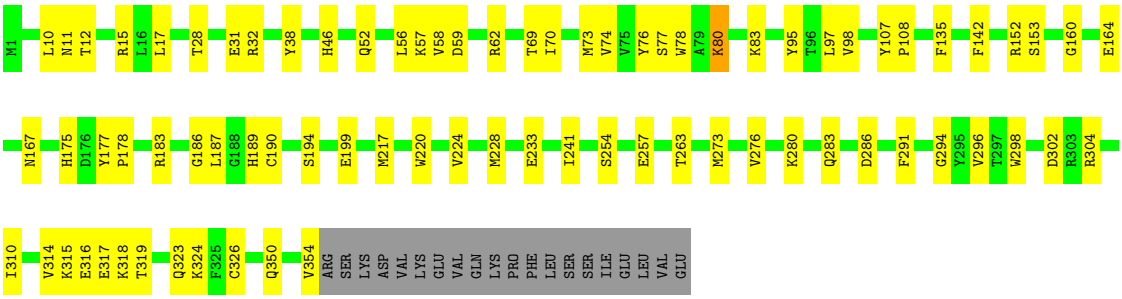
3 Residue-property plots (i)

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.

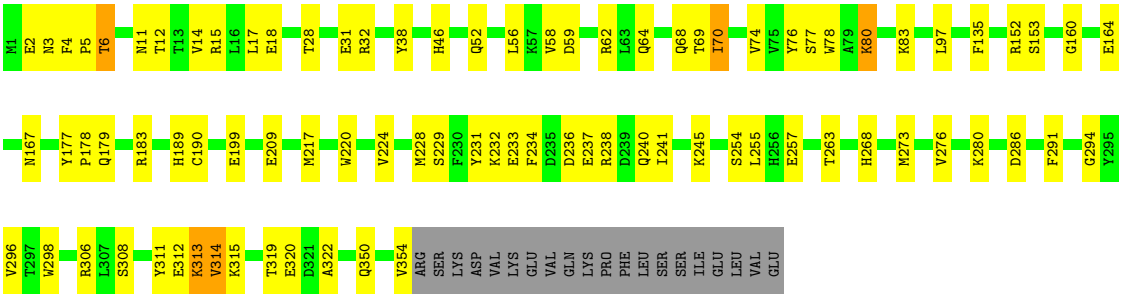
• Molecule 1: trichodiene synthase

Chain A: 74% 21% 5%



• Molecule 1: trichodiene synthase

Chain B: 72% 22% • 5%



4 Data and refinement statistics (i)

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

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α, β, γ	122.72Å 122.72Å 151.01Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	24.49 – 2.60	Depositor
% Data completeness (in resolution range)	99.7 (24.49-2.60)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.219 , 0.252	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	6135	wwPDB-VP
Average B, all atoms ($Å^2$)	44.0	wwPDB-VP

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: MG, EDO, POP

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	0.38	0/3026	0.54	0/4107
1	B	0.38	0/3026	0.56	0/4107
All	All	0.38	0/6052	0.55	0/8214

There are no bond length outliers.

There are no bond angle outliers.

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	2941	0	2795	64	0
1	B	2941	0	2795	65	0
2	A	8	0	12	0	0
2	B	8	0	12	0	0
3	B	2	0	0	0	0
4	B	9	0	0	0	0
5	A	129	0	0	6	0
5	B	97	0	0	3	0
All	All	6135	0	5614	127	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 11.

All (127) 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:17:LEU:HD21	1:A:296:VAL:HG11	1.32	1.10
1:B:17:LEU:HD21	1:B:296:VAL:HG11	1.41	0.99
1:A:59:ASP:HB3	1:A:62:ARG:HG3	1.64	0.79
1:B:59:ASP:HB3	1:B:62:ARG:HG3	1.69	0.75
1:A:254:SER:OG	1:A:257:GLU:HG3	1.89	0.73
1:B:237:GLU:HA	1:B:237:GLU:OE2	1.90	0.71
1:B:254:SER:OG	1:B:257:GLU:HG3	1.92	0.69
1:A:17:LEU:CD2	1:A:296:VAL:HG11	2.20	0.68
1:A:324:LYS:HD2	5:A:823:HOH:O	1.95	0.67
1:B:17:LEU:CD2	1:B:296:VAL:HG11	2.22	0.67
1:A:319:THR:O	1:A:323:GLN:HG2	1.95	0.66
1:B:313:LYS:O	1:B:313:LYS:HG2	1.93	0.66
1:B:217:MET:HE1	1:B:220:TRP:HB3	1.78	0.66
1:A:217:MET:CE	1:A:220:TRP:HE3	2.10	0.65
1:A:217:MET:HE1	1:A:220:TRP:HB3	1.78	0.64
1:B:229:SER:O	1:B:233:GLU:HG3	1.97	0.64
1:A:319:THR:HG22	5:A:800:HOH:O	1.98	0.64
1:A:175:HIS:HD2	1:B:268:HIS:NE2	1.95	0.63
1:A:199:GLU:HG3	5:A:817:HOH:O	2.01	0.59
1:A:217:MET:HE2	1:A:220:TRP:HE3	1.68	0.59
1:A:38:TYR:CD2	1:A:83:LYS:HB3	2.37	0.59
1:B:59:ASP:HB3	1:B:62:ARG:CG	2.33	0.58
1:A:70:ILE:HD13	1:A:97:LEU:HD22	1.86	0.58
1:A:46:HIS:O	1:A:52:GLN:HG3	2.05	0.57
1:A:10:LEU:HD11	1:A:314:VAL:HG11	1.87	0.57
1:A:241:ILE:HG13	1:A:241:ILE:O	2.05	0.56
1:A:217:MET:HE1	1:A:220:TRP:CE3	2.40	0.56
1:B:217:MET:CE	1:B:220:TRP:HE3	2.19	0.56
1:A:11:ASN:O	1:A:15:ARG:HG3	2.06	0.55
1:A:57:LYS:HE2	5:A:773:HOH:O	2.05	0.55
1:A:28:THR:OG1	1:A:31:GLU:HG3	2.06	0.54
1:B:38:TYR:CD2	1:B:83:LYS:HB3	2.42	0.54
1:A:217:MET:CE	1:A:220:TRP:CE3	2.90	0.54
1:B:241:ILE:HG13	1:B:241:ILE:O	2.08	0.54
1:B:12:THR:HG23	1:B:263:THR:HG23	1.91	0.53
1:A:220:TRP:CZ2	1:A:224:VAL:HG21	2.43	0.53
1:B:11:ASN:O	1:B:15:ARG:HG3	2.08	0.53
1:B:46:HIS:O	1:B:52:GLN:HG3	2.08	0.53
1:A:107:TYR:HB3	1:A:108:PRO:HD3	1.91	0.53
1:A:59:ASP:HB3	1:A:62:ARG:CG	2.36	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:4:PHE:C	1:B:6:THR:H	2.12	0.52
1:B:217:MET:HE1	1:B:220:TRP:CE3	2.44	0.52
1:B:70:ILE:HD13	1:B:97:LEU:HD22	1.91	0.52
1:B:236:ASP:OD1	1:B:238:ARG:N	2.39	0.51
1:A:217:MET:CE	1:A:220:TRP:HB3	2.39	0.51
1:B:237:GLU:OE2	1:B:240:GLN:HA	2.11	0.51
1:B:160:GLY:O	1:B:164:GLU:HG2	2.11	0.50
1:B:217:MET:CE	1:B:220:TRP:CE3	2.94	0.50
1:A:302:ASP:OD1	1:A:304:ARG:HB3	2.12	0.50
1:B:308:SER:O	1:B:312:GLU:HG2	2.11	0.50
1:A:160:GLY:O	1:A:164:GLU:HG2	2.12	0.50
1:A:153:SER:HB3	1:A:190:CYS:HB2	1.94	0.50
1:B:152:ARG:NH2	1:B:189:HIS:ND1	2.59	0.50
1:A:69:THR:HG23	1:A:298:TRP:HZ2	1.75	0.49
1:A:318:LYS:HA	1:A:323:GLN:HE21	1.76	0.49
1:A:12:THR:HG23	1:A:263:THR:HG23	1.92	0.49
1:A:177:TYR:HB3	1:A:178:PRO:HD3	1.94	0.49
1:A:283:GLN:HA	1:A:283:GLN:OE1	2.12	0.49
1:B:240:GLN:O	1:B:245:LYS:HD2	2.12	0.49
1:B:76:TYR:O	1:B:294:GLY:HA3	2.12	0.49
1:B:32:ARG:HG3	1:B:32:ARG:HH11	1.78	0.48
1:A:58:VAL:HG21	1:A:98:VAL:HG11	1.96	0.48
1:B:217:MET:CE	1:B:220:TRP:HB3	2.44	0.48
1:B:314:VAL:CG1	1:B:322:ALA:HB1	2.42	0.48
1:B:319:THR:HG22	1:B:320:GLU:N	2.29	0.48
1:A:80:LYS:HD2	1:A:286:ASP:OD2	2.14	0.48
1:A:152:ARG:NH2	1:A:189:HIS:ND1	2.61	0.48
1:A:76:TYR:O	1:A:294:GLY:HA3	2.12	0.47
1:B:217:MET:HE2	1:B:220:TRP:HE3	1.79	0.47
1:A:32:ARG:HH11	1:A:32:ARG:HG3	1.79	0.47
1:B:28:THR:OG1	1:B:31:GLU:HG3	2.13	0.47
1:A:276:VAL:O	1:A:280:LYS:HD3	2.14	0.47
1:B:234:PHE:O	1:B:234:PHE:HD2	1.97	0.47
1:B:314:VAL:HG13	1:B:322:ALA:HB1	1.96	0.47
1:B:179:GLN:HG2	5:B:837:HOH:O	2.14	0.47
1:B:80:LYS:HD2	1:B:286:ASP:OD2	2.14	0.46
1:B:153:SER:HB3	1:B:190:CYS:HB2	1.97	0.46
1:B:69:THR:HG23	1:B:298:TRP:HZ2	1.80	0.46
1:B:167:ASN:HA	1:B:241:ILE:HD13	1.98	0.46
1:A:32:ARG:HD3	1:A:76:TYR:CE1	2.51	0.46
1:B:4:PHE:O	1:B:6:THR:N	2.49	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:231:TYR:C	1:B:233:GLU:H	2.19	0.46
1:B:183:ARG:NH1	5:B:758:HOH:O	2.49	0.46
1:A:70:ILE:HD13	1:A:97:LEU:CD2	2.46	0.45
1:B:77:SER:HB3	1:B:291:PHE:CD1	2.50	0.45
1:A:319:THR:O	1:A:323:GLN:CG	2.63	0.45
1:B:320:GLU:HG2	1:B:320:GLU:O	2.17	0.45
1:B:276:VAL:O	1:B:280:LYS:HD3	2.17	0.45
1:A:318:LYS:HA	1:A:323:GLN:NE2	2.32	0.44
1:B:74:VAL:HA	1:B:78:TRP:CE3	2.52	0.44
1:A:217:MET:O	1:A:217:MET:HE3	2.16	0.44
1:B:237:GLU:HB3	1:B:240:GLN:HE21	1.82	0.44
1:B:220:TRP:CZ2	1:B:224:VAL:HG21	2.53	0.44
1:B:234:PHE:O	1:B:234:PHE:CD2	2.71	0.44
1:A:12:THR:CG2	1:A:263:THR:HG23	2.48	0.44
1:B:64:GLN:O	1:B:68:GLN:HG3	2.18	0.44
1:A:70:ILE:CD1	1:A:97:LEU:HD22	2.46	0.44
1:B:308:SER:O	1:B:311:TYR:HB3	2.17	0.44
1:B:199:GLU:HG3	5:B:766:HOH:O	2.18	0.43
1:B:234:PHE:HE1	1:B:255:LEU:HD22	1.83	0.43
1:A:220:TRP:CE2	1:A:224:VAL:HG21	2.53	0.43
1:A:153:SER:OG	1:A:187:LEU:HA	2.18	0.43
1:A:315:LYS:HA	1:A:326:CYS:SG	2.59	0.43
1:B:14:VAL:HG12	1:B:18:GLU:OE2	2.18	0.43
1:B:312:GLU:O	1:B:315:LYS:HG2	2.18	0.43
1:A:74:VAL:HA	1:A:78:TRP:CE3	2.54	0.42
1:B:17:LEU:HD21	1:B:296:VAL:CG1	2.30	0.42
1:B:56:LEU:HG	1:B:58:VAL:CG2	2.49	0.42
1:A:186:GLY:O	1:A:187:LEU:HB2	2.19	0.42
1:B:177:TYR:HB3	1:B:178:PRO:HD3	2.01	0.42
1:A:314:VAL:HG12	1:A:317:GLU:OE2	2.19	0.42
1:A:228:MET:HE2	1:A:296:VAL:HG13	2.02	0.42
1:A:73:MET:HB2	1:A:298:TRP:CE2	2.54	0.41
1:A:183:ARG:NH1	5:A:759:HOH:O	2.52	0.41
1:B:32:ARG:HD3	1:B:76:TYR:CE1	2.55	0.41
1:A:233:GLU:HG2	5:A:776:HOH:O	2.20	0.41
1:B:2:GLU:C	1:B:3:ASN:HD22	2.23	0.41
1:A:142:PHE:CE2	1:A:194:SER:HA	2.55	0.41
1:A:175:HIS:CD2	1:B:268:HIS:NE2	2.83	0.41
1:A:310:ILE:O	1:A:314:VAL:HG22	2.21	0.41
1:A:56:LEU:HG	1:A:58:VAL:CG2	2.50	0.41
1:A:350:GLN:O	1:A:354:VAL:HG23	2.19	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:52:GLN:OE1	1:A:95:TYR:OH	2.39	0.41
1:A:77:SER:HB3	1:A:291:PHE:CD1	2.56	0.41
1:B:231:TYR:HE2	1:B:306:ARG:O	2.03	0.41
1:B:350:GLN:O	1:B:354:VAL:HG23	2.21	0.41
1:B:224:VAL:O	1:B:228:MET:HG2	2.21	0.40

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	352/374 (94%)	345 (98%)	7 (2%)	0	100	100
1	B	352/374 (94%)	333 (95%)	14 (4%)	5 (1%)	11	22
All	All	704/748 (94%)	678 (96%)	21 (3%)	5 (1%)	22	43

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	6	THR
1	B	5	PRO
1	B	232	LYS
1	B	313	LYS
1	B	314	VAL

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	320/340 (94%)	315 (98%)	5 (2%)	62	82
1	B	320/340 (94%)	315 (98%)	5 (2%)	62	82
All	All	640/680 (94%)	630 (98%)	10 (2%)	62	82

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	80	LYS
1	A	135	PHE
1	A	167	ASN
1	A	273	MET
1	A	316	GLU
1	B	70	ILE
1	B	80	LYS
1	B	135	PHE
1	B	209	GLU
1	B	273	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (15) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	54	GLN
1	A	175	HIS
1	A	219	ASN
1	A	323	GLN
1	A	331	GLN
1	A	350	GLN
1	B	3	ASN
1	B	54	GLN
1	B	167	ASN
1	B	219	ASN
1	B	225	ASN
1	B	240	GLN
1	B	283	GLN
1	B	323	GLN
1	B	350	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 monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 7 ligands modelled in this entry, 2 are monoatomic - leaving 5 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	$\#\|Z\| > 2$
2	EDO	B	753	-	3,3,3	2.22	2 (66%)	2,2,2	0.49	0
2	EDO	A	752	-	3,3,3	2.34	2 (66%)	2,2,2	0.39	0
2	EDO	B	751	-	3,3,3	2.25	2 (66%)	2,2,2	0.45	0
4	POP	B	700	3	6,8,8	1.50	1 (16%)	13,13,13	1.74	2 (15%)
2	EDO	A	750	-	3,3,3	2.33	2 (66%)	2,2,2	0.46	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
2	EDO	B	753	-	-	0/1/1/1	-
2	EDO	A	752	-	-	0/1/1/1	-
2	EDO	B	751	-	-	0/1/1/1	-
4	POP	B	700	3	-	0/6/6/6	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	EDO	A	750	-	-	0/1/1/1	-

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	752	EDO	O2-C2	3.20	1.58	1.42
2	A	750	EDO	O2-C2	3.00	1.57	1.42
2	B	753	EDO	O2-C2	3.00	1.57	1.42
2	B	751	EDO	O2-C2	2.94	1.57	1.42
2	A	750	EDO	O1-C1	2.52	1.55	1.42
4	B	700	POP	P2-O6	-2.46	1.45	1.54
2	B	751	EDO	O1-C1	2.39	1.54	1.42
2	A	752	EDO	O1-C1	2.34	1.54	1.42
2	B	753	EDO	O1-C1	2.28	1.53	1.42

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	B	700	POP	O2-P1-O	5.02	121.48	104.64
4	B	700	POP	O3-P1-O	-2.07	97.70	104.64

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)

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains (i)

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates (i)

EDS was not executed - this section is therefore empty.

6.4 Ligands (i)

EDS was not executed - this section is therefore empty.

6.5 Other polymers (i)

EDS was not executed - this section is therefore empty.