wwPDB X-ray Structure Validation Summary Report (i)

Jul 8, 2025 – 07:10 pm BST

PDB ID	:	9ENO / pdb_00009eno
Title	:	Crystal structure of ComplemEnT1.4 (CEnT1.4), an engineered photoenzyme for selective [2+2]-cycloadditions
Authors	:	Hardy, F.J.; Crawshaw, R.C.; Green, A.P.
Deposited on	:	2024-03-13
Resolution	:	1.73 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 (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:

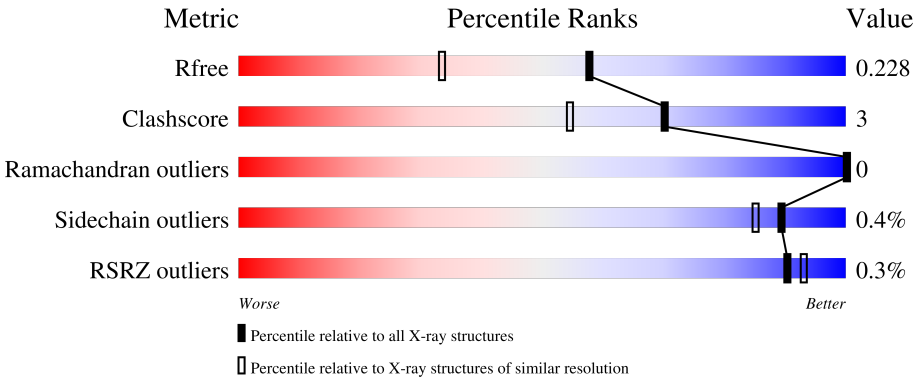
MolProbity	:	4-5-2 with Phenix2.0rc1
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.0rc1
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.003 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.44

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 1.73 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}	164625	1043 (1.74-1.74)
Clashscore	180529	1119 (1.74-1.74)
Ramachandran outliers	177936	1112 (1.74-1.74)
Sidechain outliers	177891	1112 (1.74-1.74)
RSRZ outliers	164620	1043 (1.74-1.74)

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% 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	330	85% 8% 8%
1	B	330	86% 7% 7%

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 10115 atoms, of which 4787 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 Diisopropyl-fluorophosphatase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	305	Total	C	H	N	O	S	0	5	0
			4755	1539	2351	402	446	17			
1	B	307	Total	C	H	N	O	S	0	8	0
			4809	1559	2376	403	455	16			

There are 72 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	initiating methionine	UNP Q7SIG4
A	-18	GLY	-	expression tag	UNP Q7SIG4
A	-17	SER	-	expression tag	UNP Q7SIG4
A	-16	SER	-	expression tag	UNP Q7SIG4
A	-15	HIS	-	expression tag	UNP Q7SIG4
A	-14	HIS	-	expression tag	UNP Q7SIG4
A	-13	HIS	-	expression tag	UNP Q7SIG4
A	-12	HIS	-	expression tag	UNP Q7SIG4
A	-11	HIS	-	expression tag	UNP Q7SIG4
A	-10	HIS	-	expression tag	UNP Q7SIG4
A	-9	SER	-	expression tag	UNP Q7SIG4
A	-8	SER	-	expression tag	UNP Q7SIG4
A	-7	GLY	-	expression tag	UNP Q7SIG4
A	-6	LEU	-	expression tag	UNP Q7SIG4
A	-5	VAL	-	expression tag	UNP Q7SIG4
A	-4	PRO	-	expression tag	UNP Q7SIG4
A	-3	ARG	-	expression tag	UNP Q7SIG4
A	-2	GLY	-	expression tag	UNP Q7SIG4
A	-1	SER	-	expression tag	UNP Q7SIG4
A	0	HIS	-	expression tag	UNP Q7SIG4
A	21	THR	GLU	conflict	UNP Q7SIG4
A	37	PHE	GLU	conflict	UNP Q7SIG4
A	120	ALA	ASN	conflict	UNP Q7SIG4
A	121	TYR	ASP	conflict	UNP Q7SIG4
A	144	PHE	TYR	conflict	UNP Q7SIG4

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Chain	Residue	Modelled	Actual	Comment	Reference
A	146	LEU	ARG	conflict	UNP Q7SIG4
A	148	VAL	MET	conflict	UNP Q7SIG4
A	149	ASP	GLN	conflict	UNP Q7SIG4
A	173	ALA	PHE	conflict	UNP Q7SIG4
A	175	ALA	ASN	conflict	UNP Q7SIG4
A	195	GLN	THR	conflict	UNP Q7SIG4
A	225	VAL	GLU	conflict	UNP Q7SIG4
A	229	ALA	ASP	conflict	UNP Q7SIG4
A	244	PBF	TRP	conflict	UNP Q7SIG4
A	271	VAL	SER	conflict	UNP Q7SIG4
A	272	ALA	ASN	conflict	UNP Q7SIG4
B	-19	MET	-	initiating methionine	UNP Q7SIG4
B	-18	GLY	-	expression tag	UNP Q7SIG4
B	-17	SER	-	expression tag	UNP Q7SIG4
B	-16	SER	-	expression tag	UNP Q7SIG4
B	-15	HIS	-	expression tag	UNP Q7SIG4
B	-14	HIS	-	expression tag	UNP Q7SIG4
B	-13	HIS	-	expression tag	UNP Q7SIG4
B	-12	HIS	-	expression tag	UNP Q7SIG4
B	-11	HIS	-	expression tag	UNP Q7SIG4
B	-10	HIS	-	expression tag	UNP Q7SIG4
B	-9	SER	-	expression tag	UNP Q7SIG4
B	-8	SER	-	expression tag	UNP Q7SIG4
B	-7	GLY	-	expression tag	UNP Q7SIG4
B	-6	LEU	-	expression tag	UNP Q7SIG4
B	-5	VAL	-	expression tag	UNP Q7SIG4
B	-4	PRO	-	expression tag	UNP Q7SIG4
B	-3	ARG	-	expression tag	UNP Q7SIG4
B	-2	GLY	-	expression tag	UNP Q7SIG4
B	-1	SER	-	expression tag	UNP Q7SIG4
B	0	HIS	-	expression tag	UNP Q7SIG4
B	21	THR	GLU	conflict	UNP Q7SIG4
B	37	PHE	GLU	conflict	UNP Q7SIG4
B	120	ALA	ASN	conflict	UNP Q7SIG4
B	121	TYR	ASP	conflict	UNP Q7SIG4
B	144	PHE	TYR	conflict	UNP Q7SIG4
B	146	LEU	ARG	conflict	UNP Q7SIG4
B	148	VAL	MET	conflict	UNP Q7SIG4
B	149	ASP	GLN	conflict	UNP Q7SIG4
B	173	ALA	PHE	conflict	UNP Q7SIG4
B	175	ALA	ASN	conflict	UNP Q7SIG4
B	195	GLN	THR	conflict	UNP Q7SIG4

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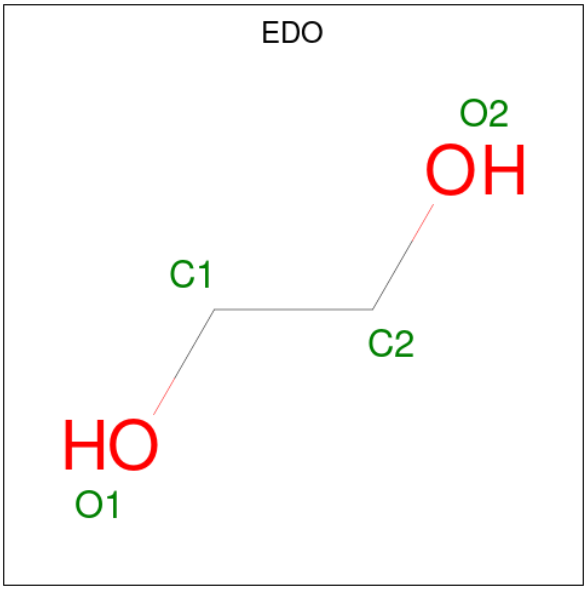
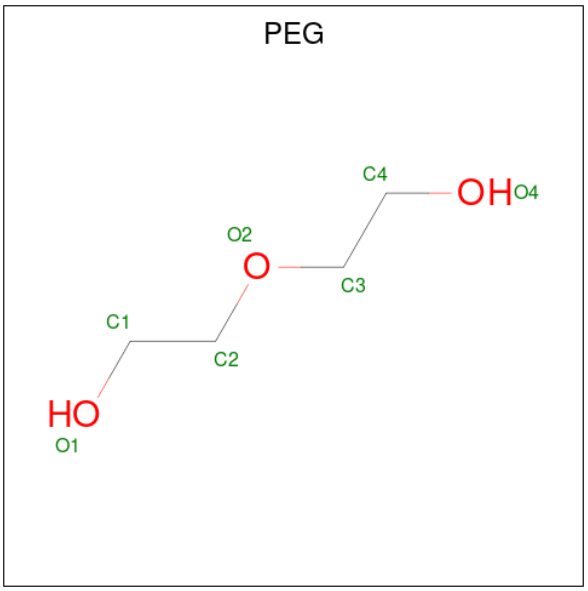
Chain	Residue	Modelled	Actual	Comment	Reference
B	225	VAL	GLU	conflict	UNP Q7SIG4
B	229	ALA	ASP	conflict	UNP Q7SIG4
B	244	PBF	TRP	conflict	UNP Q7SIG4
B	271	VAL	SER	conflict	UNP Q7SIG4
B	272	ALA	ASN	conflict	UNP Q7SIG4

- Molecule 2 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: $C_2H_6O_2$).



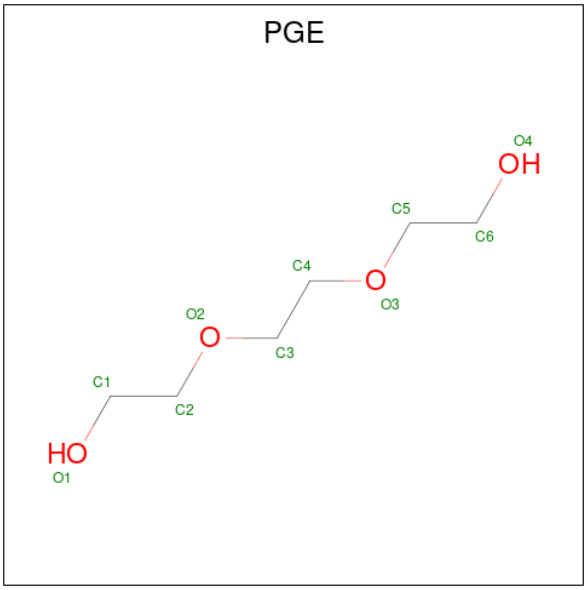
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C H O 10 2 6 2	0	0
2	A	1	Total C H O 10 2 6 2	0	0

- Molecule 3 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula: $C_4H_{10}O_3$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	B	1	Total	C	H	O	0	0
			17	4	10	3		
3	B	1	Total	C	H	O	0	0
			17	4	10	3		

- Molecule 4 is TRIETHYLENE GLYCOL (CCD ID: PGE) (formula: $C_6H_{14}O_4$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	B	1	Total	C	H	O	0	1
			48	12	28	8		

- Molecule 5 is water.

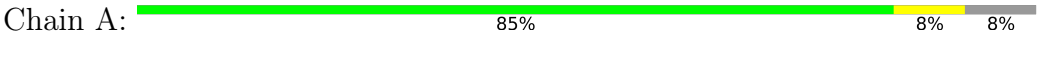
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	213	Total O 213 213	0	0
5	B	236	Total O 236 236	0	0

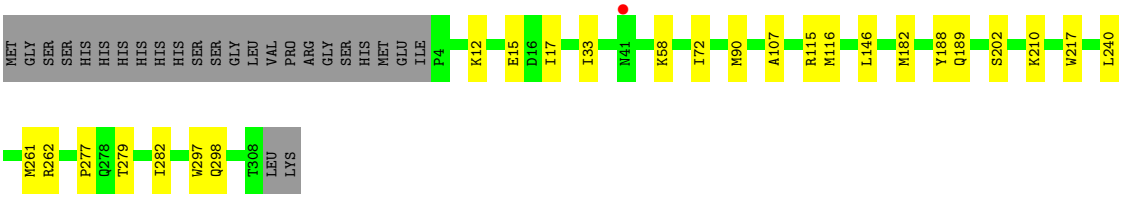
3 Residue-property plots (i)

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 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 (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: Diisopropyl-fluorophosphatase

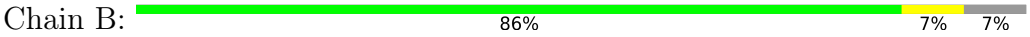
Chain A:





- Molecule 1: Diisopropyl-fluorophosphatase

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	51.97Å 73.92Å 74.87Å 90.00° 92.85° 90.00°	Depositor
Resolution (Å)	51.91 – 1.73 51.91 – 1.73	Depositor EDS
% Data completeness (in resolution range)	98.9 (51.91-1.73) 99.0 (51.91-1.73)	Depositor EDS
R_{merge}	0.17	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.01 (at 1.73Å)	Xtriage
Refinement program	PDB-REDO, PHENIX 1.20.1_4487	Depositor
R, R_{free}	0.181 , 0.226 0.186 , 0.228	Depositor DCC
R_{free} test set	2134 reflections (3.55%)	wwPDB-VP
Wilson B-factor (Å^2)	24.1	Xtriage
Anisotropy	0.170	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.40 , 34.6	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.000 for -h,l,k 0.015 for -h,-l,-k 0.039 for h,-k,-l	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	10115	wwPDB-VP
Average B, all atoms (Å^2)	31.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.44% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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: PGE, PEG, PBF, EDO

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	0.28	0/2459	0.54	0/3327
1	B	0.29	0/2497	0.54	0/3383
All	All	0.29	0/4956	0.54	0/6710

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand.A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	B	0	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	180	ARG	Sidechain

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	2404	2351	2359	18	0
1	B	2433	2376	2388	14	0
2	A	8	12	12	0	0
3	B	14	20	20	0	0
4	B	20	28	28	0	0
5	A	213	0	0	0	0
5	B	236	0	0	2	0
All	All	5328	4787	4807	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 3.

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)
1:A:17:ILE:HD13	1:A:33:ILE:HD11	1.55	0.87
1:A:182:MET:HA	1:A:182:MET:HE2	1.71	0.72
1:B:159:THR:OG1	1:B:161[B]:ASP:OD1	2.06	0.71
1:A:17:ILE:CD1	1:A:33:ILE:HD11	2.32	0.58
1:B:115:ARG:HH11	1:B:115:ARG:HG3	1.69	0.57

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	307/330 (93%)	295 (96%)	12 (4%)	0	100	100
1	B	312/330 (94%)	299 (96%)	13 (4%)	0	100	100
All	All	619/660 (94%)	594 (96%)	25 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	254/271 (94%)	253 (100%)	1 (0%)	89	85
1	B	259/271 (96%)	257 (99%)	2 (1%)	79	70
All	All	513/542 (95%)	510 (99%)	3 (1%)	89	78

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	115	ARG
1	B	231[A]	MET
1	B	231[B]	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 7 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	28	ASN
1	B	163	GLN
1	B	278	GLN
1	B	258	GLN
1	A	304	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)

2 non-standard protein/DNA/RNA residues 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	$\#\|Z\| > 2$
1	PBF	B	244	1	19,20,21	0.81	0	23,26,28	1.06	1 (4%)
1	PBF	A	244	1	19,20,21	0.75	0	23,26,28	0.48	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
1	PBF	B	244	1	-	4/13/14/16	0/2/2/2
1	PBF	A	244	1	-	0/13/14/16	0/2/2/2

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	244	PBF	ON2-CN1-CT	-2.13	116.72	120.12

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	B	244	PBF	ON2-CN1-CT-CI1
1	B	244	PBF	ON2-CN1-CT-CI2
1	B	244	PBF	CZ-CN1-CT-CI1
1	B	244	PBF	CZ-CN1-CT-CI2

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	B	244	PBF	1	0

5.5 Carbohydrates (i)

There are no oligosaccharides in this entry.

5.6 Ligand geometry (i)

6 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	EDO	A	402	-	3,3,3	0.50	0	2,2,2	0.29	0
4	PGE	B	402[A]	-	9,9,9	0.34	0	8,8,8	0.40	0
2	EDO	A	401	-	3,3,3	0.46	0	2,2,2	0.38	0
3	PEG	B	403	-	6,6,6	0.12	0	5,5,5	0.12	0
3	PEG	B	401	-	6,6,6	0.13	0	5,5,5	0.16	0
4	PGE	B	402[B]	-	9,9,9	0.30	0	8,8,8	0.34	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	A	402	-	-	1/1/1/1	-
4	PGE	B	402[A]	-	-	4/7/7/7	-
2	EDO	A	401	-	-	0/1/1/1	-
3	PEG	B	403	-	-	4/4/4/4	-
3	PEG	B	401	-	-	3/4/4/4	-
4	PGE	B	402[B]	-	-	5/7/7/7	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

5 of 17 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	403	PEG	O1-C1-C2-O2
4	B	402[B]	PGE	O2-C3-C4-O3
4	B	402[A]	PGE	O2-C3-C4-O3

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Mol	Chain	Res	Type	Atoms
4	B	402[A]	PGE	O1-C1-C2-O2
4	B	402[A]	PGE	O3-C5-C6-O4

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

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, 95^{th} 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	304/330 (92%)	-0.15	1 (0%)	90	93	13, 29, 44, 65	5 (1%)
1	B	306/330 (92%)	-0.24	1 (0%)	90	93	12, 27, 43, 64	8 (2%)
All	All	610/660 (92%)	-0.20	2 (0%)	90	93	12, 28, 44, 65	13 (2%)

All (2) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	309	LEU	2.6
1	A	41	ASN	2.1

6.2 Non-standard residues in protein, DNA, RNA chains

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, 95^{th} 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
1	PBF	A	244	19/20	0.94	0.09	21,32,53,64	0
1	PBF	B	244	19/20	0.95	0.10	18,28,70,71	0

6.3 Carbohydrates

There are no oligosaccharides in this entry.

6.4 Ligands

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, 95^{th} 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
4	PGE	B	402[A]	10/10	0.81	0.12	24,33,40,43	24
4	PGE	B	402[B]	10/10	0.81	0.12	27,34,39,40	24
3	PEG	B	403	7/7	0.83	0.12	38,46,56,58	0
3	PEG	B	401	7/7	0.84	0.12	36,45,53,64	0
2	EDO	A	401	4/4	0.87	0.10	41,49,54,58	0
2	EDO	A	402	4/4	0.87	0.10	32,40,51,61	0

6.5 Other polymers (i)

There are no such residues in this entry.