



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 8, 2026 – 04:15 PM UTC

PDB ID : 5C78 / pdb_00005c78
Title : ATP-driven lipid-linked oligosaccharide flippase PglK in apo-inward state (1)
Authors : Perez, C.; Locher, K.P.
Deposited on : 2015-06-24
Resolution : 2.90 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 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

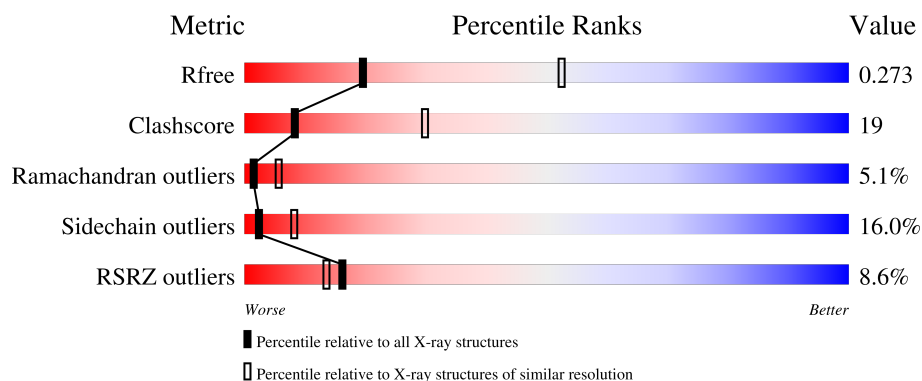
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.90 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	2481 (2.90-2.90)
Clashscore	190562	2690 (2.90-2.90)
Ramachandran outliers	187476	2623 (2.90-2.90)
Sidechain outliers	187428	2625 (2.90-2.90)
RSRZ outliers	180081	2481 (2.90-2.90)

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	564	8% 52% 37% 10% .
1	B	564	10% 53% 35% 10% .
1	C	564	8% 52% 37% 10% .
1	D	564	9% 51% 35% 12% .

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 18423 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 ATP-driven flippase PglK.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	564	Total	C	N	O	S	0	0	0
			4557	3000	732	811	14			
1	B	564	Total	C	N	O	S	0	0	0
			4557	3000	732	811	14			
1	C	564	Total	C	N	O	S	0	0	0
			4557	3000	732	811	14			
1	D	564	Total	C	N	O	S	0	0	0
			4557	3000	732	811	14			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	2	VAL	LEU	conflict	UNP O86150
A	105	LYS	TYR	conflict	UNP O86150
A	510	GLN	GLU	conflict	UNP O86150
B	2	VAL	LEU	conflict	UNP O86150
B	105	LYS	TYR	conflict	UNP O86150
B	510	GLN	GLU	conflict	UNP O86150
C	2	VAL	LEU	conflict	UNP O86150
C	105	LYS	TYR	conflict	UNP O86150
C	510	GLN	GLU	conflict	UNP O86150
D	2	VAL	LEU	conflict	UNP O86150
D	105	LYS	TYR	conflict	UNP O86150
D	510	GLN	GLU	conflict	UNP O86150

- Molecule 2 is PENTAETHYLENE GLYCOL (CCD ID: 1PE) (formula: C₁₀H₂₂O₆).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			16	10	6		
2	B	1	Total	C	O	0	0
			16	10	6		
2	B	1	Total	C	O	0	0
			16	10	6		
2	C	1	Total	C	O	0	0
			16	10	6		
2	D	1	Total	C	O	0	0
			16	10	6		

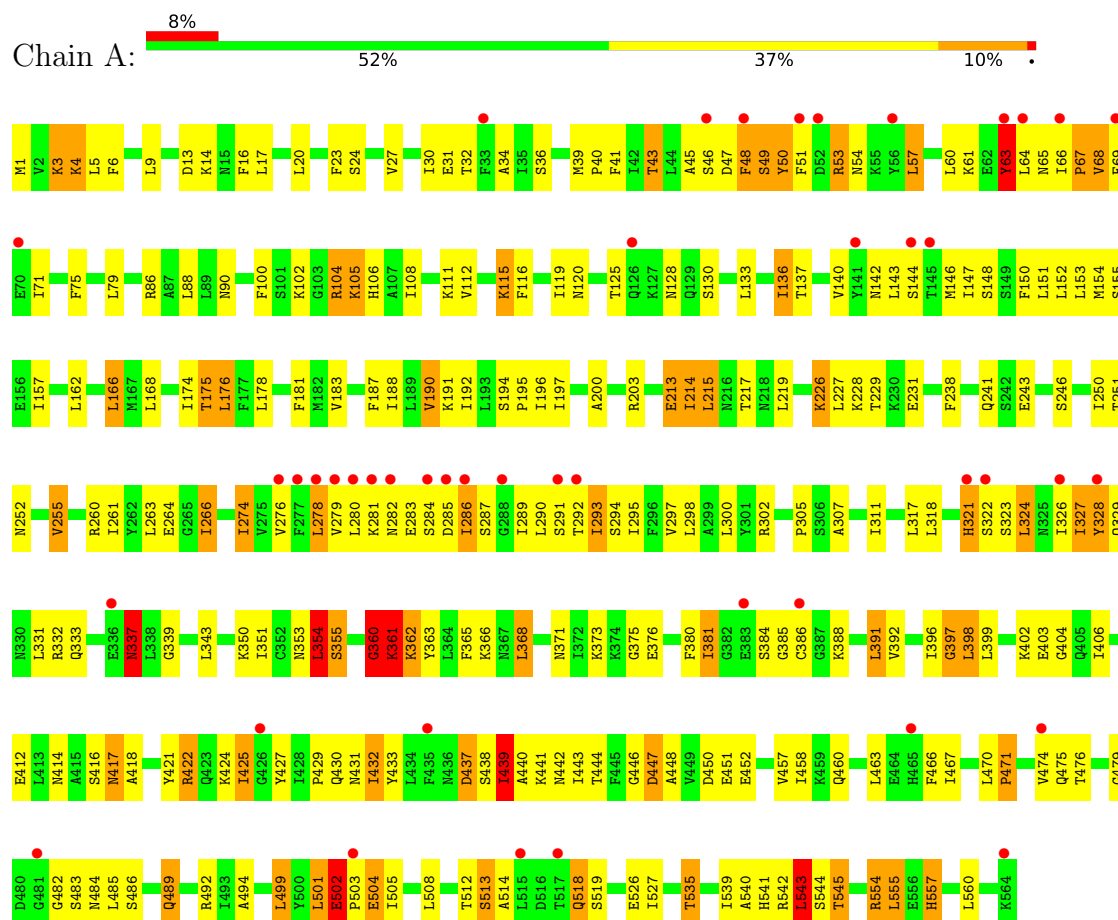
- Molecule 3 is water.

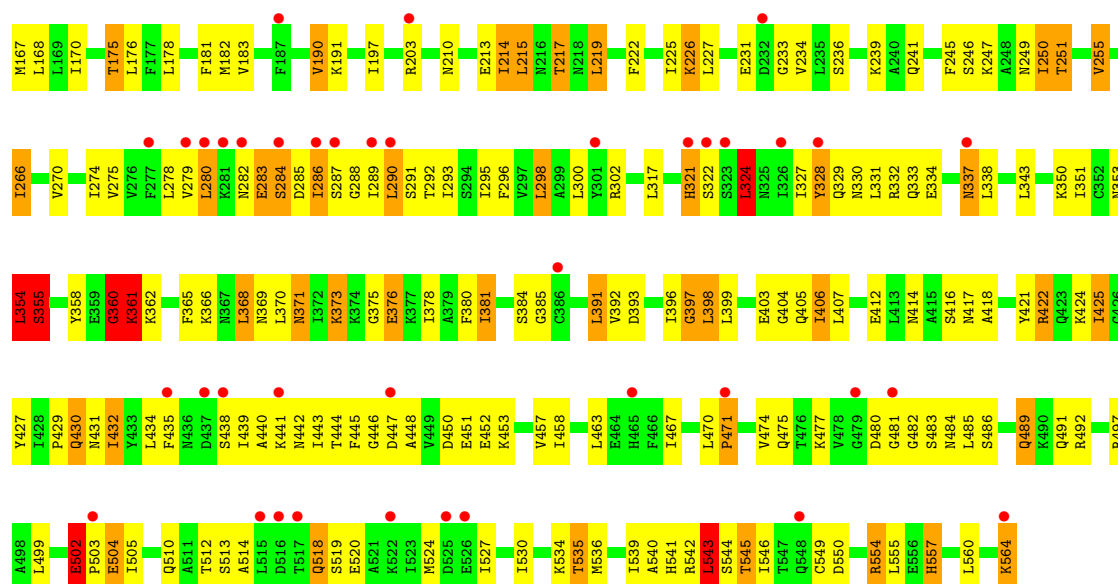
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	27	Total	O	0	0
			27	27		
3	B	26	Total	O	0	0
			26	26		
3	C	27	Total	O	0	0
			27	27		
3	D	35	Total	O	0	0
			35	35		

3 Residue-property plots

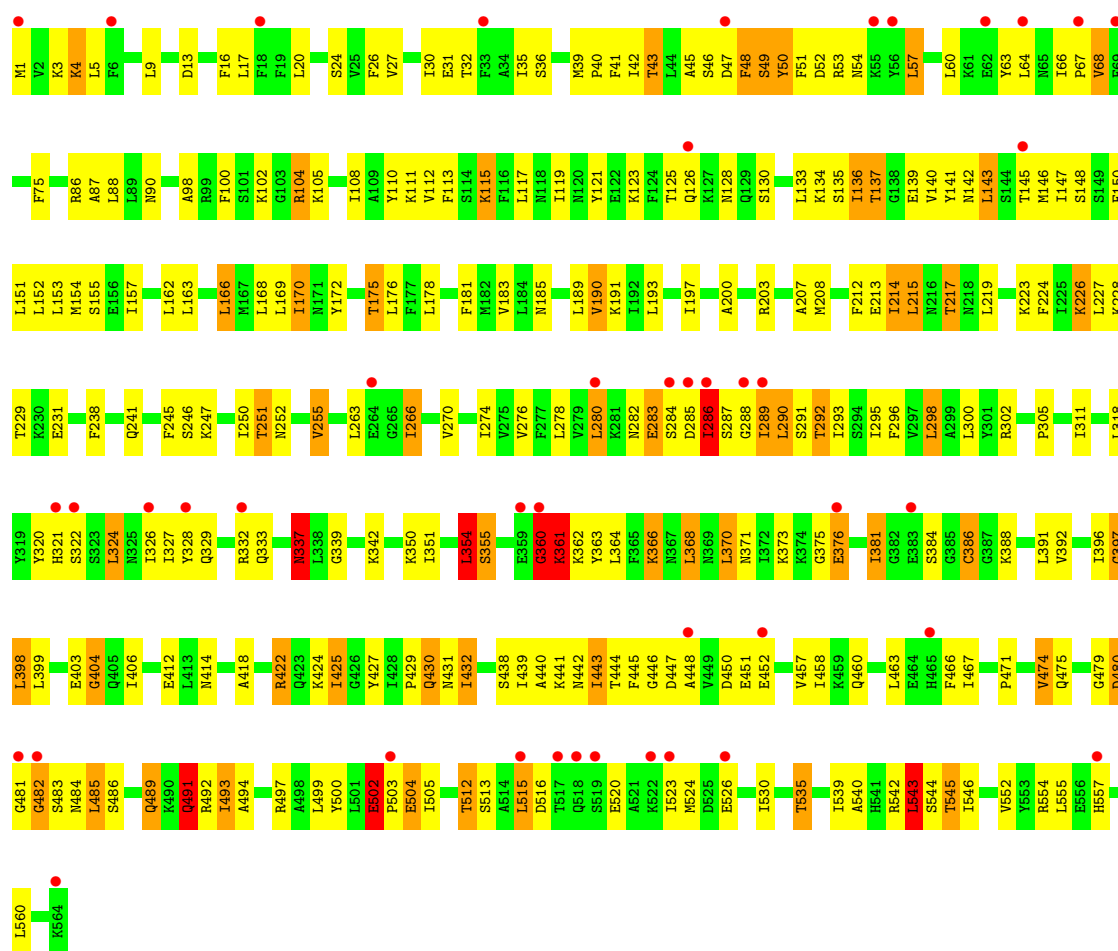
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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: ATP-driven flippase PgIK





• Molecule 1: ATP-driven flippase PglK



• Molecule 1: ATP-driven flippase PglK



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	96.60Å 114.42Å 145.59Å 68.44° 73.27° 68.67°	Depositor
Resolution (Å)	27.93 – 2.90 27.93 – 2.90	Depositor EDS
% Data completeness (in resolution range)	87.2 (27.93-2.90) 87.1 (27.93-2.90)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.28 (at 2.81Å)	Xtriage
Refinement program	PHENIX	Depositor
R, R_{free}	0.232 , 0.267 0.240 , 0.273	Depositor DCC
R_{free} test set	5179 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	71.6	Xtriage
Anisotropy	0.008	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.26 , 54.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	18423	wwPDB-VP
Average B, all atoms (Å ²)	80.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.41% 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: 1PE

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	0.69	1/4641 (0.0%)	1.08	16/6246 (0.3%)
1	B	0.68	0/4641	1.07	14/6246 (0.2%)
1	C	0.70	0/4641	1.08	21/6246 (0.3%)
1	D	0.72	1/4641 (0.0%)	1.11	16/6246 (0.3%)
All	All	0.70	2/18564 (0.0%)	1.09	67/24984 (0.3%)

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	A	0	1
1	B	0	1
1	C	0	1
1	D	0	1
All	All	0	4

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	328	TYR	CA-C	-7.56	1.45	1.52
1	D	328	TYR	CA-C	-5.34	1.47	1.52

The worst 5 of 67 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	279	VAL	N-CA-C	-8.98	104.40	113.47
1	D	545	THR	N-CA-C	-8.88	101.78	114.12
1	A	279	VAL	N-CA-C	-8.59	104.80	113.47

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	397	GLY	N-CA-C	8.13	121.93	112.50
1	A	397	GLY	N-CA-C	7.53	121.24	112.50

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	502	GLU	Peptide
1	B	502	GLU	Peptide
1	C	502	GLU	Peptide
1	D	502	GLU	Peptide

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	4557	0	4764	189	0
1	B	4557	0	4764	193	0
1	C	4557	0	4764	185	0
1	D	4557	0	4764	198	0
2	A	16	0	22	0	0
2	B	32	0	44	1	0
2	C	16	0	22	1	0
2	D	16	0	22	1	0
3	A	27	0	0	0	0
3	B	26	0	0	1	0
3	C	27	0	0	0	0
3	D	35	0	0	5	0
All	All	18423	0	19166	719	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 19.

The worst 5 of 719 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:4:LYS:HG3	1:A:329:GLN:HG3	1.44	1.00
1:C:4:LYS:HG3	1:C:329:GLN:HG3	1.45	0.98
1:B:4:LYS:HG3	1:B:329:GLN:HG3	1.46	0.98
1:D:4:LYS:HG3	1:D:329:GLN:HG3	1.48	0.95
1:B:119:ILE:O	1:C:226:LYS:NZ	2.00	0.94

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	562/564 (100%)	475 (84%)	58 (10%)	29 (5%)	1	5
1	B	562/564 (100%)	475 (84%)	57 (10%)	30 (5%)	1	5
1	C	562/564 (100%)	473 (84%)	62 (11%)	27 (5%)	2	7
1	D	562/564 (100%)	476 (85%)	57 (10%)	29 (5%)	1	5
All	All	2248/2256 (100%)	1899 (84%)	234 (10%)	115 (5%)	1	6

5 of 115 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	49	SER
1	A	50	TYR
1	A	67	PRO
1	A	282	ASN
1	A	284	SER

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	505/505 (100%)	425 (84%)	80 (16%)	2	8
1	B	505/505 (100%)	422 (84%)	83 (16%)	2	8
1	C	505/505 (100%)	426 (84%)	79 (16%)	2	9
1	D	505/505 (100%)	424 (84%)	81 (16%)	2	8
All	All	2020/2020 (100%)	1697 (84%)	323 (16%)	2	8

5 of 323 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	432	ILE
1	D	270	VAL
1	C	512	THR
1	D	128	ASN
1	D	368	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 19 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	367	ASN
1	D	462	ASN
1	D	491	GLN
1	D	405	GLN
1	C	118	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

5 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	1PE	C	601	-	15,15,15	1.06	0	14,14,14	0.69	0
2	1PE	D	601	-	15,15,15	1.04	0	14,14,14	0.74	0
2	1PE	A	601	-	15,15,15	1.16	0	14,14,14	0.67	0
2	1PE	B	602	-	15,15,15	0.93	0	14,14,14	0.43	0
2	1PE	B	601	-	15,15,15	1.06	0	14,14,14	0.58	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	1PE	C	601	-	-	7/13/13/13	-
2	1PE	D	601	-	-	10/13/13/13	-
2	1PE	A	601	-	-	6/13/13/13	-
2	1PE	B	602	-	-	8/13/13/13	-
2	1PE	B	601	-	-	10/13/13/13	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

5 of 41 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	602	1PE	C24-C14-OH5-C25
2	B	602	1PE	C16-C26-OH6-C15
2	A	601	1PE	OH6-C15-C25-OH5
2	B	602	1PE	OH2-C12-C22-OH3
2	D	601	1PE	OH6-C15-C25-OH5

There are no ring outliers.

3 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	601	1PE	1	0
2	D	601	1PE	1	0
2	B	602	1PE	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	564/564 (100%)	0.41	44 (7%)	19 16	34, 71, 144, 270	0
1	B	564/564 (100%)	0.38	55 (9%)	13 11	32, 74, 151, 231	0
1	C	564/564 (100%)	0.40	44 (7%)	19 16	36, 74, 149, 283	0
1	D	564/564 (100%)	0.34	51 (9%)	15 13	28, 70, 149, 261	0
All	All	2256/2256 (100%)	0.38	194 (8%)	16 13	28, 72, 150, 283	0

The worst 5 of 194 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	286	ILE	8.9
1	C	286	ILE	8.6
1	A	564	LYS	7.3
1	A	286	ILE	7.3
1	B	286	ILE	7.2

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 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
2	1PE	B	602	16/16	0.77	0.15	117,119,121,121	0
2	1PE	C	601	16/16	0.88	0.17	62,63,65,66	0
2	1PE	D	601	16/16	0.89	0.17	62,65,68,70	0
2	1PE	A	601	16/16	0.91	0.13	50,51,53,53	0
2	1PE	B	601	16/16	0.95	0.09	45,46,49,50	0

6.5 Other polymers [i](#)

There are no such residues in this entry.