



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 8, 2026 – 09:10 AM UTC

PDB ID : 7Z8N / pdb_00007z8n
Title : GacS histidine kinase from *Pseudomonas aeruginosa*
Authors : Fadel, F.; Bassim, V.; Francis, V.I.; Porter, S.L.; Botzanowski, T.; Legrand, P.; Bourne, Y.; Cianferani, S.; Vincent, F.
Deposited on : 2022-03-17
Resolution : 2.64 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

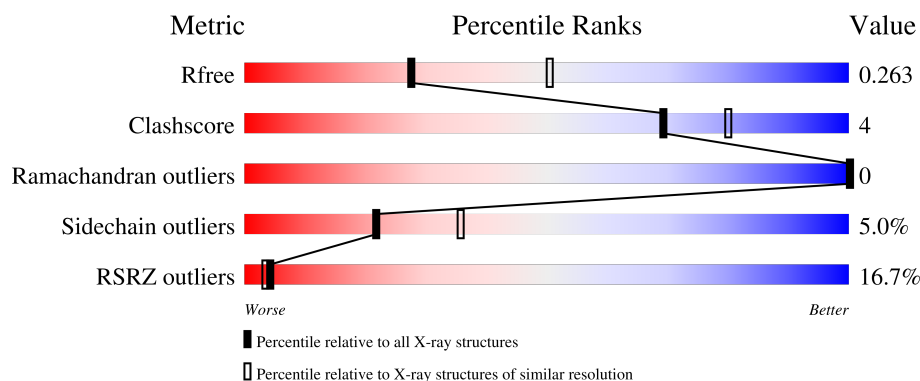
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.64 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	2053 (2.66-2.62)
Clashscore	190562	2097 (2.66-2.62)
Ramachandran outliers	187476	2066 (2.66-2.62)
Sidechain outliers	187428	2066 (2.66-2.62)
RSRZ outliers	180081	2052 (2.66-2.62)

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	317	21% 79% 12% 8%
1	B	317	3% 83% 7% 8%
1	C	317	22% 80% 11% 8%
1	D	317	14% 81% 10% 8%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 9296 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 Histidine kinase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	292	Total	C	N	O	Se	0	2	0
			2269	1409	392	461	7			
1	B	292	Total	C	N	O	Se	0	6	0
			2299	1429	396	467	7			
1	C	292	Total	C	N	O	Se	0	2	0
			2269	1408	393	462	6			
1	D	292	Total	C	N	O	Se	0	1	0
			2263	1404	392	461	6			

There are 96 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	196	MSE	-	initiating methionine	UNP G3XD98
A	197	GLY	-	expression tag	UNP G3XD98
A	198	HIS	-	expression tag	UNP G3XD98
A	199	HIS	-	expression tag	UNP G3XD98
A	200	HIS	-	expression tag	UNP G3XD98
A	201	HIS	-	expression tag	UNP G3XD98
A	202	HIS	-	expression tag	UNP G3XD98
A	203	HIS	-	expression tag	UNP G3XD98
A	204	SER	-	expression tag	UNP G3XD98
A	205	SER	-	expression tag	UNP G3XD98
A	206	GLY	-	expression tag	UNP G3XD98
A	207	VAL	-	expression tag	UNP G3XD98
A	208	ASP	-	expression tag	UNP G3XD98
A	209	LEU	-	expression tag	UNP G3XD98
A	210	GLY	-	expression tag	UNP G3XD98
A	211	THR	-	expression tag	UNP G3XD98
A	212	GLU	-	expression tag	UNP G3XD98
A	213	ASN	-	expression tag	UNP G3XD98
A	214	LEU	-	expression tag	UNP G3XD98
A	215	TYR	-	expression tag	UNP G3XD98
A	216	PHE	-	expression tag	UNP G3XD98

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Chain	Residue	Modelled	Actual	Comment	Reference
A	217	GLN	-	expression tag	UNP G3XD98
A	218	SER	-	expression tag	UNP G3XD98
A	219	MSE	-	expression tag	UNP G3XD98
B	196	MSE	-	initiating methionine	UNP G3XD98
B	197	GLY	-	expression tag	UNP G3XD98
B	198	HIS	-	expression tag	UNP G3XD98
B	199	HIS	-	expression tag	UNP G3XD98
B	200	HIS	-	expression tag	UNP G3XD98
B	201	HIS	-	expression tag	UNP G3XD98
B	202	HIS	-	expression tag	UNP G3XD98
B	203	HIS	-	expression tag	UNP G3XD98
B	204	SER	-	expression tag	UNP G3XD98
B	205	SER	-	expression tag	UNP G3XD98
B	206	GLY	-	expression tag	UNP G3XD98
B	207	VAL	-	expression tag	UNP G3XD98
B	208	ASP	-	expression tag	UNP G3XD98
B	209	LEU	-	expression tag	UNP G3XD98
B	210	GLY	-	expression tag	UNP G3XD98
B	211	THR	-	expression tag	UNP G3XD98
B	212	GLU	-	expression tag	UNP G3XD98
B	213	ASN	-	expression tag	UNP G3XD98
B	214	LEU	-	expression tag	UNP G3XD98
B	215	TYR	-	expression tag	UNP G3XD98
B	216	PHE	-	expression tag	UNP G3XD98
B	217	GLN	-	expression tag	UNP G3XD98
B	218	SER	-	expression tag	UNP G3XD98
B	219	MSE	-	expression tag	UNP G3XD98
C	196	MSE	-	initiating methionine	UNP G3XD98
C	197	GLY	-	expression tag	UNP G3XD98
C	198	HIS	-	expression tag	UNP G3XD98
C	199	HIS	-	expression tag	UNP G3XD98
C	200	HIS	-	expression tag	UNP G3XD98
C	201	HIS	-	expression tag	UNP G3XD98
C	202	HIS	-	expression tag	UNP G3XD98
C	203	HIS	-	expression tag	UNP G3XD98
C	204	SER	-	expression tag	UNP G3XD98
C	205	SER	-	expression tag	UNP G3XD98
C	206	GLY	-	expression tag	UNP G3XD98
C	207	VAL	-	expression tag	UNP G3XD98
C	208	ASP	-	expression tag	UNP G3XD98
C	209	LEU	-	expression tag	UNP G3XD98
C	210	GLY	-	expression tag	UNP G3XD98

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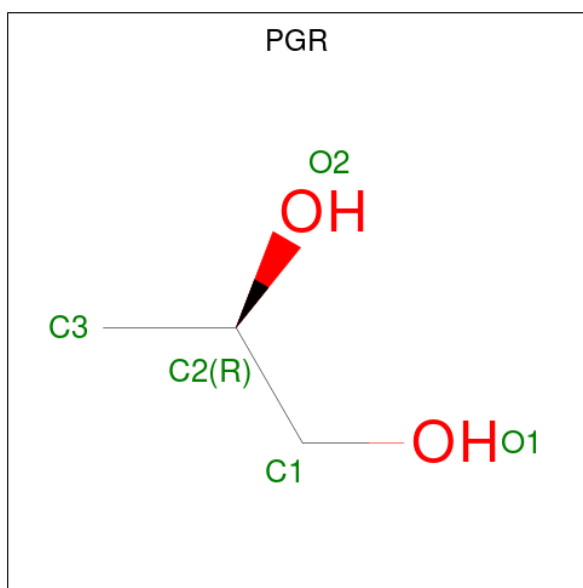
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Chain	Residue	Modelled	Actual	Comment	Reference
C	211	THR	-	expression tag	UNP G3XD98
C	212	GLU	-	expression tag	UNP G3XD98
C	213	ASN	-	expression tag	UNP G3XD98
C	214	LEU	-	expression tag	UNP G3XD98
C	215	TYR	-	expression tag	UNP G3XD98
C	216	PHE	-	expression tag	UNP G3XD98
C	217	GLN	-	expression tag	UNP G3XD98
C	218	SER	-	expression tag	UNP G3XD98
C	219	MSE	-	expression tag	UNP G3XD98
D	196	MSE	-	initiating methionine	UNP G3XD98
D	197	GLY	-	expression tag	UNP G3XD98
D	198	HIS	-	expression tag	UNP G3XD98
D	199	HIS	-	expression tag	UNP G3XD98
D	200	HIS	-	expression tag	UNP G3XD98
D	201	HIS	-	expression tag	UNP G3XD98
D	202	HIS	-	expression tag	UNP G3XD98
D	203	HIS	-	expression tag	UNP G3XD98
D	204	SER	-	expression tag	UNP G3XD98
D	205	SER	-	expression tag	UNP G3XD98
D	206	GLY	-	expression tag	UNP G3XD98
D	207	VAL	-	expression tag	UNP G3XD98
D	208	ASP	-	expression tag	UNP G3XD98
D	209	LEU	-	expression tag	UNP G3XD98
D	210	GLY	-	expression tag	UNP G3XD98
D	211	THR	-	expression tag	UNP G3XD98
D	212	GLU	-	expression tag	UNP G3XD98
D	213	ASN	-	expression tag	UNP G3XD98
D	214	LEU	-	expression tag	UNP G3XD98
D	215	TYR	-	expression tag	UNP G3XD98
D	216	PHE	-	expression tag	UNP G3XD98
D	217	GLN	-	expression tag	UNP G3XD98
D	218	SER	-	expression tag	UNP G3XD98
D	219	MSE	-	expression tag	UNP G3XD98

- Molecule 2 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total Ca 1 1	0	0
2	B	2	Total Ca 2 2	0	0

- Molecule 3 is R-1,2-PROPANEDIOL (CCD ID: PGR) (formula: $C_3H_8O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	B	1	Total	C	O	0	0
			5	3	2		
3	B	1	Total	C	O	0	0
			5	3	2		
3	B	1	Total	C	O	0	0
			5	3	2		

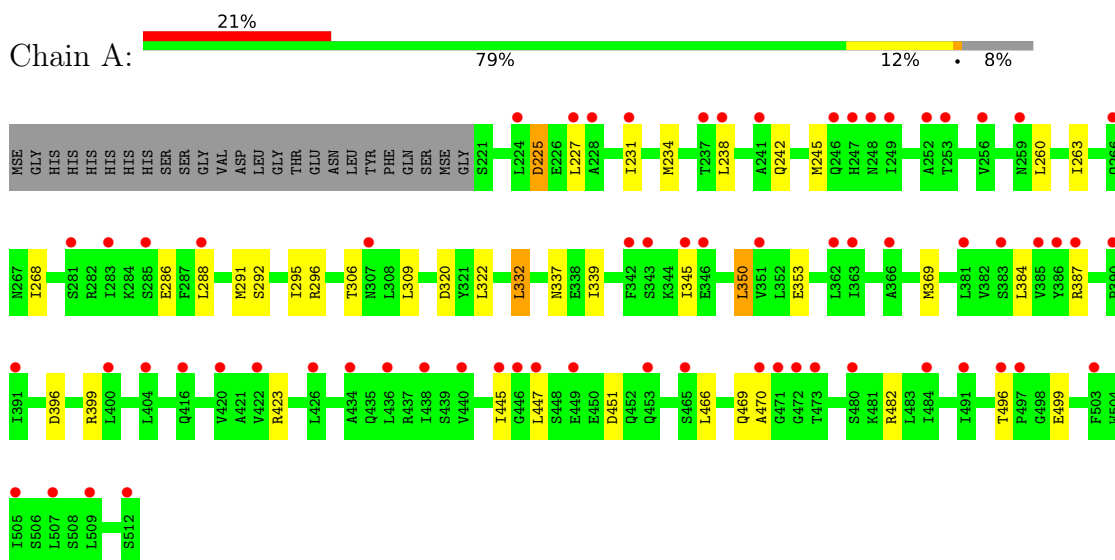
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	35	Total	O	0	0
			35	35		
4	B	105	Total	O	0	0
			105	105		
4	C	18	Total	O	0	0
			18	18		
4	D	20	Total	O	0	0
			20	20		

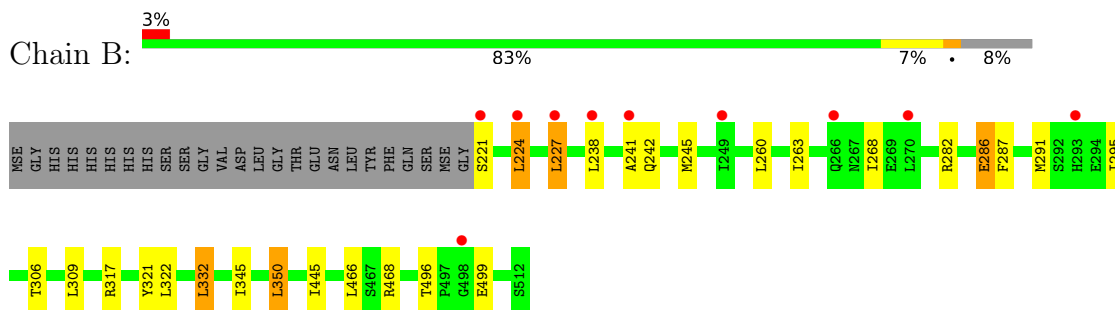
3 Residue-property plots [i](#)

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.

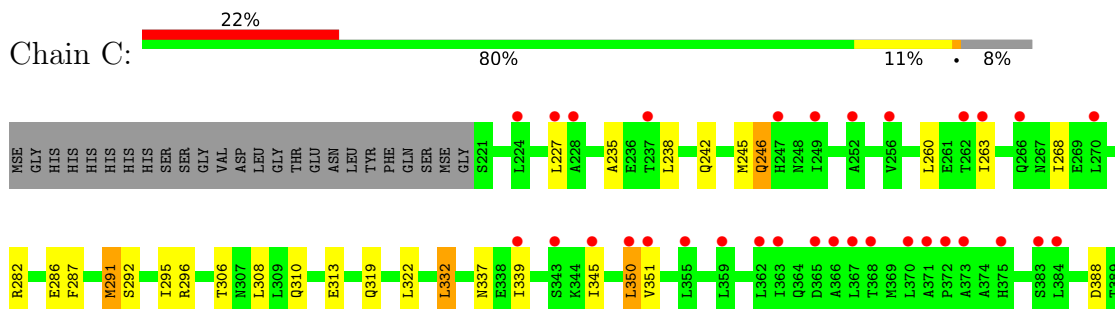
• Molecule 1: Histidine kinase

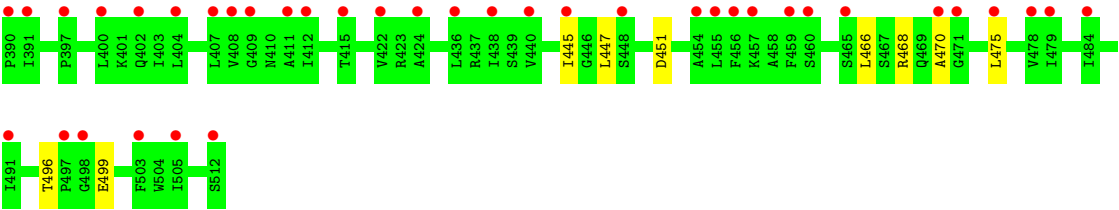


• Molecule 1: Histidine kinase

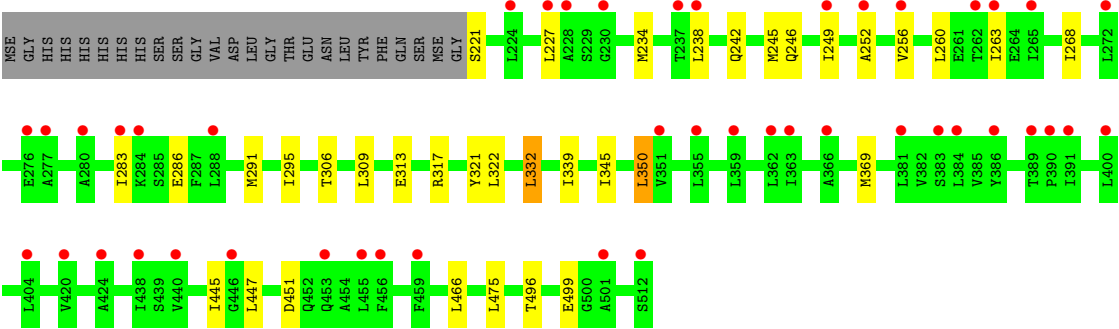
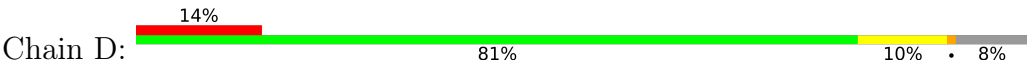


• Molecule 1: Histidine kinase





● Molecule 1: Histidine kinase



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	63.71Å 76.85Å 178.65Å 90.00° 97.30° 90.00°	Depositor
Resolution (Å)	48.81 – 2.64 48.81 – 2.64	Depositor EDS
% Data completeness (in resolution range)	89.0 (48.81-2.64) 89.0 (48.81-2.64)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.82 (at 2.65Å)	Xtriage
Refinement program	BUSTER 2.10.4 (3-FEB-2022)	Depositor
R, R_{free}	0.259 , 0.264 0.256 , 0.263	Depositor DCC
R_{free} test set	2266 reflections (4.48%)	wwPDB-VP
Wilson B-factor (Å ²)	71.8	Xtriage
Anisotropy	0.026	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.28 , 68.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.006 for h,-k,-h-l	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	9296	wwPDB-VP
Average B, all atoms (Å ²)	131.0	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 23.65 % 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 4.4744e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹ Intensities estimated from amplitudes.

² Theoretical 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: CA, PGR

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	0.65	0/2291	1.02	1/3081 (0.0%)
1	B	0.70	0/2329	1.01	0/3133
1	C	0.62	0/2291	0.99	0/3082
1	D	0.62	0/2282	1.00	2/3070 (0.1%)
All	All	0.65	0/9193	1.01	3/12366 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	225	ASP	CA-CB-CG	5.76	118.36	112.60
1	D	221	SER	CA-C-N	5.20	129.79	122.46
1	D	221	SER	C-N-CA	5.20	129.79	122.46

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	2269	0	2286	26	0
1	B	2299	0	2306	22	0
1	C	2269	0	2283	23	0
1	D	2263	0	2275	20	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	A	1	0	0	0	0
2	B	2	0	0	0	0
3	B	15	0	24	0	0
4	A	35	0	0	0	0
4	B	105	0	0	0	0
4	C	18	0	0	0	0
4	D	20	0	0	0	0
All	All	9296	0	9174	64	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 4.

The worst 5 of 64 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:286:GLU:HB3	1:C:470:ALA:HB1	1.50	0.92
1:C:242:GLN:HA	1:C:245:MSE:HG2	1.59	0.82
1:C:238:LEU:HD21	1:D:238:LEU:HD21	1.63	0.80
1:C:260:LEU:HA	1:C:263:ILE:HG12	1.65	0.78
1:A:260:LEU:HA	1:A:263:ILE:HG12	1.66	0.77

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	292/317 (92%)	290 (99%)	2 (1%)	0	100	100
1	B	296/317 (93%)	294 (99%)	2 (1%)	0	100	100
1	C	292/317 (92%)	290 (99%)	2 (1%)	0	100	100
1	D	291/317 (92%)	289 (99%)	2 (1%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
All	All	1171/1268 (92%)	1163 (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	251/262 (96%)	237 (94%)	14 (6%)	19	31
1	B	255/262 (97%)	245 (96%)	10 (4%)	28	47
1	C	251/262 (96%)	237 (94%)	14 (6%)	19	31
1	D	250/262 (95%)	238 (95%)	12 (5%)	23	37
All	All	1007/1048 (96%)	957 (95%)	50 (5%)	22	36

5 of 50 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	291	MSE
1	C	388	ASP
1	D	466	LEU
1	C	292	SER
1	C	332	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 20 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	246	GLN
1	D	326	GLN
1	D	461	GLN
1	D	364	GLN
1	B	310	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 oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 6 ligands modelled in this entry, 3 are monoatomic - leaving 3 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	$\# Z > 2$
3	PGR	B	603	-	4,4,4	1.04	1 (25%)	4,4,4	0.78	0
3	PGR	B	601	-	4,4,4	0.95	0	4,4,4	0.88	0
3	PGR	B	602	-	4,4,4	0.72	0	4,4,4	0.83	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
3	PGR	B	603	-	-	2/2/2/2	-
3	PGR	B	601	-	-	2/2/2/2	-
3	PGR	B	602	-	-	0/2/2/2	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	603	PGR	C1-C2	2.05	1.57	1.46

There are no bond angle outliers.

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	601	PGR	O1-C1-C2-O2
3	B	603	PGR	O1-C1-C2-C3
3	B	603	PGR	O1-C1-C2-O2
3	B	601	PGR	O1-C1-C2-C3

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](#)

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	286/317 (90%)	1.25	66 (23%) 2 1	32, 131, 219, 230	1 (0%)
1	B	286/317 (90%)	0.25	10 (3%) 47 41	32, 62, 215, 223	5 (1%)
1	C	286/317 (90%)	1.32	70 (24%) 2 1	32, 208, 240, 245	2 (0%)
1	D	286/317 (90%)	0.90	45 (15%) 5 4	37, 150, 229, 236	1 (0%)
All	All	1144/1268 (90%)	0.93	191 (16%) 4 3	32, 130, 231, 245	9 (0%)

The worst 5 of 191 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	404	LEU	6.5
1	C	459	PHE	5.7
1	C	438	ILE	5.5
1	A	249	ILE	5.4
1	A	400	LEU	5.3

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	PGR	B	603	5/5	0.67	0.22	87,87,87,87	0
3	PGR	B	601	5/5	0.74	0.24	101,101,101,101	0
2	CA	B	605	1/1	0.90	0.11	119,119,119,119	0
3	PGR	B	602	5/5	0.91	0.15	69,70,70,70	0
2	CA	B	604	1/1	0.92	0.14	117,117,117,117	0
2	CA	A	601	1/1	0.94	0.06	112,112,112,112	0

6.5 Other polymers [i](#)

There are no such residues in this entry.