



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 8, 2026 – 09:01 AM UTC

PDB ID : 4RHB / pdb_00004rhb
Title : Crystal structure of the lipopolysaccharide assembly complex LptD-LptE from the Escherichia coli outer membrane
Authors : Malojcic, G.; Garner, R.A.; Kahne, D.
Deposited on : 2014-10-01
Resolution : 3.35 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
Xtrriage (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

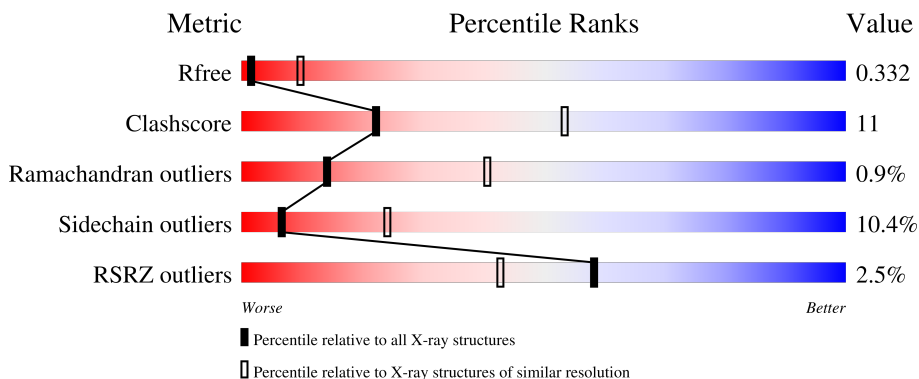
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.35 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	1099 (3.40-3.32)
Clashscore	190562	1116 (3.40-3.32)
Ramachandran outliers	187476	1101 (3.40-3.32)
Sidechain outliers	187428	1101 (3.40-3.32)
RSRZ outliers	180081	1099 (3.40-3.32)

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	614	 3% 65% 21% 9%
1	C	614	 2% 66% 21% 9%
2	B	175	 3% 62% 23% 14%
2	D	175	 % 61% 22% 14%

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 11615 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 LPS-assembly protein LptD.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	556	4618	2917	780	907	14	0	6	0
1	C	557	4626	2923	781	908	14	0	6	0

There are 64 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	179	MET	-	expression tag	UNP P31554
A	180	LYS	-	expression tag	UNP P31554
A	181	LYS	-	expression tag	UNP P31554
A	182	ARG	-	expression tag	UNP P31554
A	183	ILE	-	expression tag	UNP P31554
A	184	PRO	-	expression tag	UNP P31554
A	185	THR	-	expression tag	UNP P31554
A	186	LEU	-	expression tag	UNP P31554
A	187	LEU	-	expression tag	UNP P31554
A	188	ALA	-	expression tag	UNP P31554
A	189	THR	-	expression tag	UNP P31554
A	190	MET	-	expression tag	UNP P31554
A	191	ILE	-	expression tag	UNP P31554
A	192	ALA	-	expression tag	UNP P31554
A	193	THR	-	expression tag	UNP P31554
A	194	ALA	-	expression tag	UNP P31554
A	195	LEU	-	expression tag	UNP P31554
A	196	TYR	-	expression tag	UNP P31554
A	197	SER	-	expression tag	UNP P31554
A	198	GLN	-	expression tag	UNP P31554
A	199	GLN	-	expression tag	UNP P31554
A	200	GLY	-	expression tag	UNP P31554
A	201	LEU	-	expression tag	UNP P31554
A	202	ALA	-	expression tag	UNP P31554
A	785	HIS	-	expression tag	UNP P31554

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Chain	Residue	Modelled	Actual	Comment	Reference
A	786	HIS	-	expression tag	UNP P31554
A	787	HIS	-	expression tag	UNP P31554
A	788	HIS	-	expression tag	UNP P31554
A	789	HIS	-	expression tag	UNP P31554
A	790	HIS	-	expression tag	UNP P31554
A	791	HIS	-	expression tag	UNP P31554
A	792	HIS	-	expression tag	UNP P31554
C	179	MET	-	expression tag	UNP P31554
C	180	LYS	-	expression tag	UNP P31554
C	181	LYS	-	expression tag	UNP P31554
C	182	ARG	-	expression tag	UNP P31554
C	183	ILE	-	expression tag	UNP P31554
C	184	PRO	-	expression tag	UNP P31554
C	185	THR	-	expression tag	UNP P31554
C	186	LEU	-	expression tag	UNP P31554
C	187	LEU	-	expression tag	UNP P31554
C	188	ALA	-	expression tag	UNP P31554
C	189	THR	-	expression tag	UNP P31554
C	190	MET	-	expression tag	UNP P31554
C	191	ILE	-	expression tag	UNP P31554
C	192	ALA	-	expression tag	UNP P31554
C	193	THR	-	expression tag	UNP P31554
C	194	ALA	-	expression tag	UNP P31554
C	195	LEU	-	expression tag	UNP P31554
C	196	TYR	-	expression tag	UNP P31554
C	197	SER	-	expression tag	UNP P31554
C	198	GLN	-	expression tag	UNP P31554
C	199	GLN	-	expression tag	UNP P31554
C	200	GLY	-	expression tag	UNP P31554
C	201	LEU	-	expression tag	UNP P31554
C	202	ALA	-	expression tag	UNP P31554
C	785	HIS	-	expression tag	UNP P31554
C	786	HIS	-	expression tag	UNP P31554
C	787	HIS	-	expression tag	UNP P31554
C	788	HIS	-	expression tag	UNP P31554
C	789	HIS	-	expression tag	UNP P31554
C	790	HIS	-	expression tag	UNP P31554
C	791	HIS	-	expression tag	UNP P31554
C	792	HIS	-	expression tag	UNP P31554

- Molecule 2 is a protein called LPS-assembly lipoprotein LptE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	150	Total	C	N	O	S	0	0	0
			1181	737	215	222	7			
2	D	150	Total	C	N	O	S	0	0	0
			1181	737	215	222	7			

- Molecule 3 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Cl	0	0
			1	1		
3	C	3	Total	Cl	0	0
			3	3		

- Molecule 4 is SODIUM ION (CCD ID: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	1	Total	Na	0	0
			1	1		

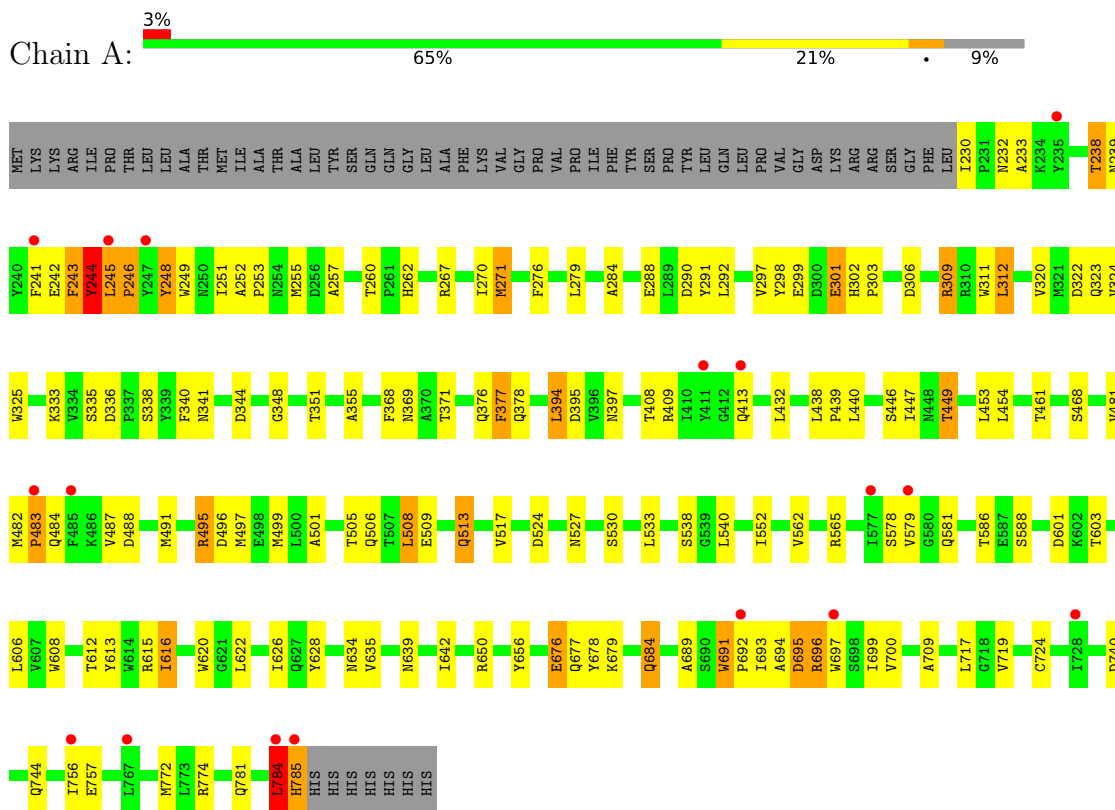
- Molecule 5 is water.

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

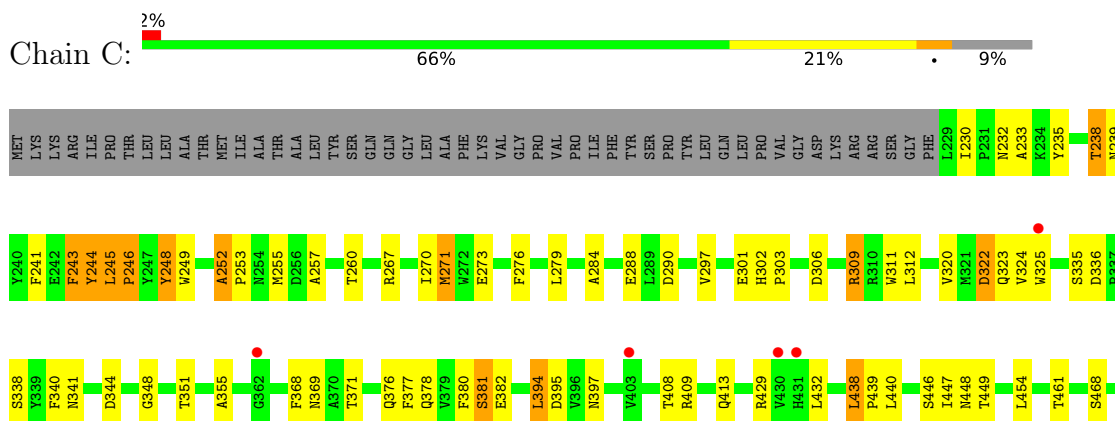
3 Residue-property plots [i](#)

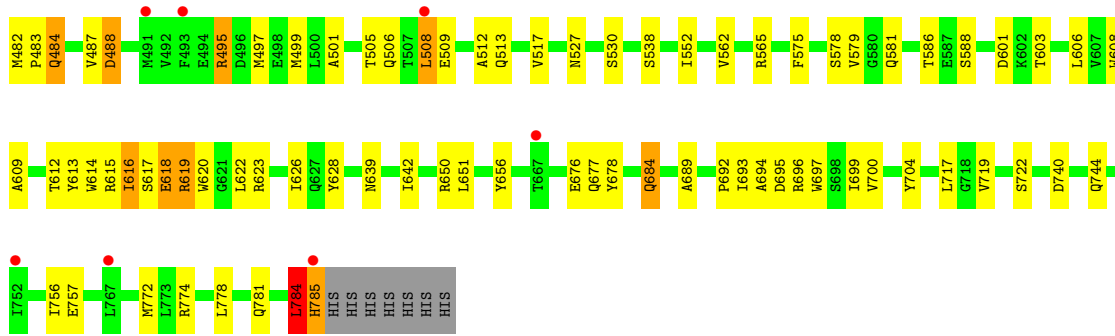
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density.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

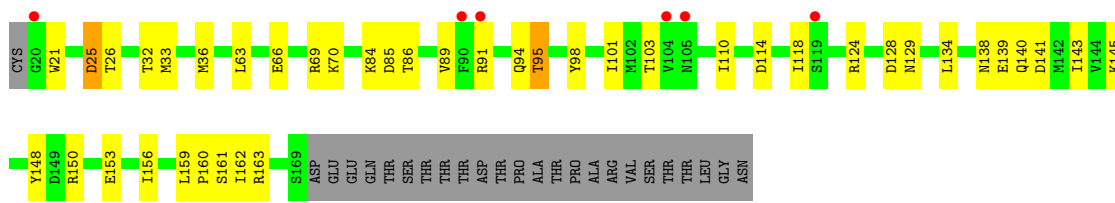


- Molecule 1: LPS-assembly protein LptD

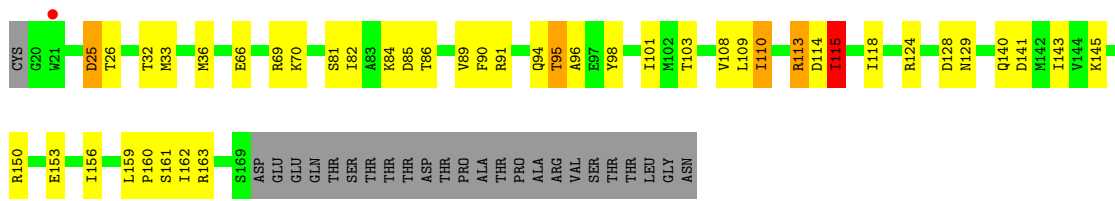




• Molecule 2: LPS-assembly lipoprotein LptE



• Molecule 2: LPS-assembly lipoprotein LptE



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	128.04Å 136.62Å 108.31Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	108.31 – 3.35 108.31 – 3.35	Depositor EDS
% Data completeness (in resolution range)	96.3 (108.31-3.35) 96.3 (108.31-3.35)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.16 (at 3.33Å)	Xtrriage
Refinement program	REFMAC 5.8.0071	Depositor
R, R_{free}	0.257 , 0.338 0.258 , 0.332	Depositor DCC
R_{free} test set	1250 reflections (4.49%)	wwPDB-VP
Wilson B-factor (Å ²)	96.2	Xtrriage
Anisotropy	0.442	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 55.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.46$, $\langle L^2 \rangle = 0.29$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	11615	wwPDB-VP
Average B, all atoms (Å ²)	117.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.31% 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: NA, CL

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	0.71	1/4756 (0.0%)	0.95	13/6477 (0.2%)
1	C	0.69	0/4764	0.92	9/6488 (0.1%)
2	B	0.70	0/1198	0.88	1/1617 (0.1%)
2	D	0.69	0/1198	0.93	2/1617 (0.1%)
All	All	0.70	1/11916 (0.0%)	0.93	25/16199 (0.2%)

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	2
1	C	0	1
All	All	0	3

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	245	LEU	CA-C	6.10	1.60	1.52

The worst 5 of 25 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	245	LEU	N-CA-C	-9.88	87.00	108.93
1	A	244[A]	TYR	N-CA-C	9.67	129.62	107.48
1	A	244[B]	TYR	N-CA-C	9.67	129.62	107.48
2	D	115	ILE	N-CA-C	7.63	120.79	108.97
1	A	244[A]	TYR	CB-CA-C	-7.22	100.98	111.23

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	244[A]	TYR	Peptide
1	A	244[B]	TYR	Peptide
1	C	784	LEU	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	4618	0	4274	96	0
1	C	4626	0	4285	97	0
2	B	1181	0	1212	25	0
2	D	1181	0	1212	37	0
3	A	1	0	0	0	0
3	C	3	0	0	0	0
4	B	1	0	0	0	0
5	A	1	0	0	0	0
5	C	3	0	0	1	0
All	All	11615	0	10983	240	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.

The worst 5 of 240 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)
2:D:108:VAL:O	2:D:115:ILE:CD1	1.73	1.34
2:D:108:VAL:O	2:D:115:ILE:HD11	1.08	1.23
1:C:235[B]:TYR:CE1	1:C:241[B]:PHE:CD1	2.29	1.21
1:C:235[B]:TYR:CE1	1:C:241[B]:PHE:HD1	1.58	1.21
1:A:297:VAL:O	1:A:301:GLU:OE1	1.59	1.20

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	560/614 (91%)	504 (90%)	51 (9%)	5 (1%)	14	41
1	C	561/614 (91%)	503 (90%)	51 (9%)	7 (1%)	10	33
2	B	148/175 (85%)	129 (87%)	19 (13%)	0	100	100
2	D	148/175 (85%)	132 (89%)	16 (11%)	0	100	100
All	All	1417/1578 (90%)	1268 (90%)	137 (10%)	12 (1%)	14	44

5 of 12 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	483	PRO
1	A	784	LEU
1	C	695	ASP
1	A	246	PRO
1	C	246	PRO

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	496/540 (92%)	445 (90%)	51 (10%)	7	25
1	C	497/540 (92%)	448 (90%)	49 (10%)	7	27
2	B	131/153 (86%)	117 (89%)	14 (11%)	6	23
2	D	131/153 (86%)	115 (88%)	16 (12%)	5	18
All	All	1255/1386 (90%)	1125 (90%)	130 (10%)	7	24

5 of 130 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	D	26	THR
2	D	89	VAL
1	A	774	ARG
1	A	724	CYS
2	D	95	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 10 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	785	HIS
2	D	94	GLN
2	D	99	GLN
2	B	140	GLN
1	C	232	ASN

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 5 ligands modelled in this entry, 5 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

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](#)

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	556/614 (90%)	-0.07	17 (3%) 51 38	36, 103, 161, 241	6 (1%)
1	C	557/614 (90%)	-0.17	12 (2%) 62 46	44, 115, 167, 203	6 (1%)
2	B	150/175 (85%)	-0.03	6 (4%) 42 29	71, 118, 177, 199	0
2	D	150/175 (85%)	-0.27	1 (0%) 84 73	84, 124, 183, 205	0
All	All	1413/1578 (89%)	-0.12	36 (2%) 58 43	36, 112, 171, 241	12 (0%)

The worst 5 of 36 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	728	ILE	7.8
1	A	756	ILE	6.0
1	C	491	MET	4.6
1	A	577	ILE	4.0
1	A	247	TYR	4.0

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 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(\AA^2)	Q<0.9
3	CL	C	801	1/1	0.90	0.12	89,89,89,89	0
3	CL	C	803	1/1	0.90	0.16	102,102,102,102	0
3	CL	C	802	1/1	0.92	0.04	83,83,83,83	0
3	CL	A	801	1/1	0.92	0.18	104,104,104,104	0
4	NA	B	201	1/1	0.92	0.26	65,65,65,65	0

6.5 Other polymers [i](#)

There are no such residues in this entry.