



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 14, 2026 – 05:29 PM UTC

PDB ID : 3NU8 / pdb_00003nu8
Title : WbpE, an Aminotransferase from *Pseudomonas aeruginosa* Involved in O-antigen Assembly in Complex with the Internal Aldimine
Authors : Larkin, A.; Olivier, N.B.; Imperiali, B.
Deposited on : 2010-07-06
Resolution : 1.50 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 ⓘ 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

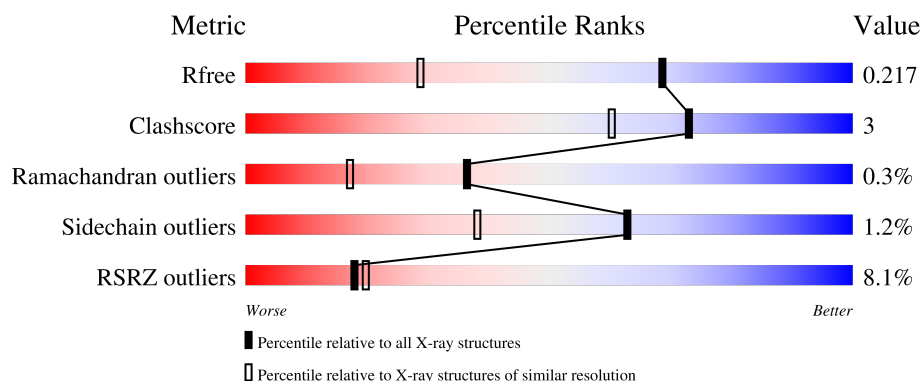
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.50 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	4037 (1.50-1.50)
Clashscore	190562	4235 (1.50-1.50)
Ramachandran outliers	187476	4153 (1.50-1.50)
Sidechain outliers	187428	4150 (1.50-1.50)
RSRZ outliers	180081	4039 (1.50-1.50)

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	359	10% 93% 6%
1	B	359	6% 94%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 6295 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 Aminotransferase WbpE.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	358	Total	C	N	O	P	S	0	1	0
			2744	1740	466	526	1	11			
1	B	359	Total	C	N	O	P	S	0	0	0
			2751	1744	469	525	1	12			

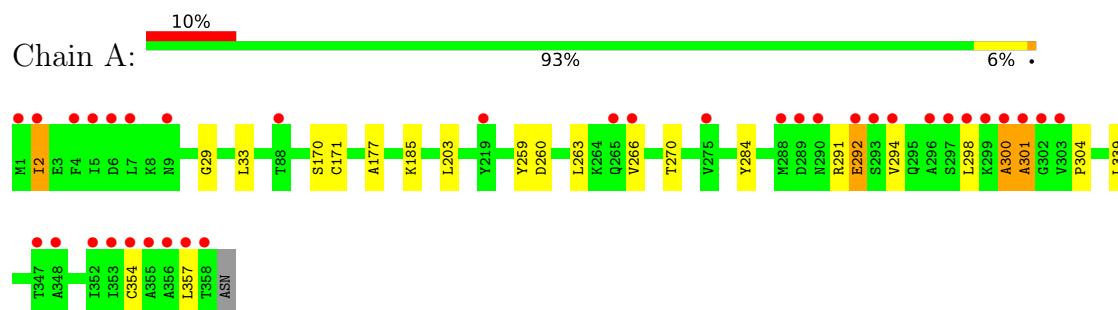
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	383	Total	O	0	0
			383	383		
2	B	417	Total	O	0	0
			417	417		

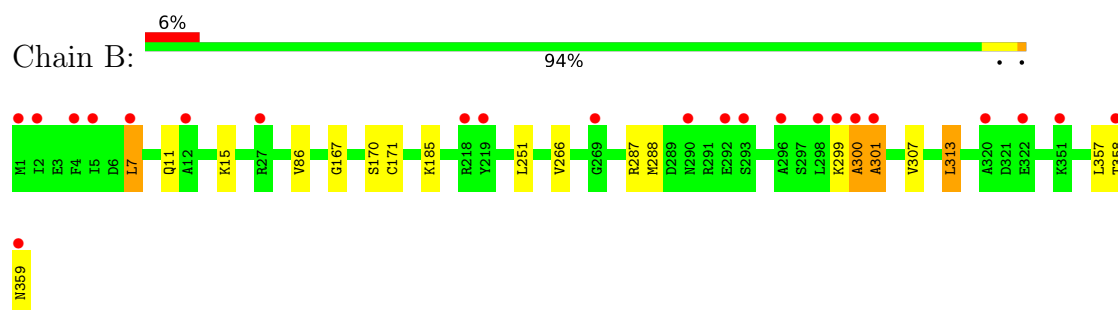
3 Residue-property plots [i](#)

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: Aminotransferase WbpE



• Molecule 1: Aminotransferase WbpE



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	77.79Å 148.72Å 53.22Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.83 – 1.50 19.83 – 1.50	Depositor EDS
% Data completeness (in resolution range)	99.7 (19.83-1.50) 99.6 (19.83-1.50)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.78 (at 1.50Å)	Xtriage
Refinement program	REFMAC 5.5.0102	Depositor
R, R_{free}	0.197 , 0.223 0.193 , 0.217	Depositor DCC
R_{free} test set	4948 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å ²)	14.7	Xtriage
Anisotropy	0.931	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , 39.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	6295	wwPDB-VP
Average B, all atoms (Å ²)	19.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.98% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: LLP

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	0.51	1/2769 (0.0%)	0.79	5/3766 (0.1%)
1	B	0.47	0/2776	0.78	2/3773 (0.1%)
All	All	0.49	1/5545 (0.0%)	0.79	7/7539 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	292	GLU	CA-C	5.76	1.60	1.52

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	292	GLU	CA-C-O	6.44	127.30	119.38
1	B	300	ALA	CA-C-N	6.26	132.96	121.70
1	B	300	ALA	C-N-CA	6.26	132.96	121.70
1	A	300	ALA	CA-C-N	6.04	132.58	121.70
1	A	300	ALA	C-N-CA	6.04	132.58	121.70
1	A	291	ARG	N-CA-C	5.94	123.45	110.80
1	A	300	ALA	N-CA-C	5.14	119.81	111.37

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	2744	0	2751	17	1
1	B	2751	0	2775	19	0
2	A	383	0	0	0	1
2	B	417	0	0	2	0
All	All	6295	0	5526	35	1

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.

All (35) 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:300:ALA:HB3	1:B:301:ALA:HB2	1.31	1.11
1:A:300:ALA:HB3	1:A:301:ALA:HB2	1.55	0.89
1:A:300:ALA:N	1:A:301:ALA:HB3	1.96	0.80
1:B:300:ALA:N	1:B:301:ALA:HB3	1.99	0.78
1:B:300:ALA:HB3	1:B:301:ALA:CB	2.13	0.76
1:A:292:GLU:OE1	1:A:292:GLU:C	2.30	0.74
1:A:2:ILE:HG22	1:A:304:PRO:HD2	1.80	0.64
1:A:300:ALA:HB3	1:A:301:ALA:CB	2.28	0.61
1:B:307:VAL:HG21	2:B:474:HOH:O	2.01	0.59
1:B:300:ALA:CB	1:B:301:ALA:HB2	2.20	0.58
1:B:300:ALA:H	1:B:301:ALA:HB3	1.68	0.57
1:B:86:VAL:HA	1:B:313:LEU:HD11	1.87	0.56
1:B:266:VAL:HG11	1:B:358:THR:HG23	1.86	0.56
1:B:357:LEU:C	1:B:359:ASN:H	2.16	0.51
1:B:299:LYS:HG2	1:B:299:LYS:O	2.11	0.50
1:B:266:VAL:HG12	1:B:266:VAL:O	2.13	0.49
1:A:29:GLY:HA3	1:B:7:LEU:HD11	1.95	0.48
1:A:171:CYS:HA	1:A:177:ALA:CB	2.44	0.47
1:A:170:SER:O	1:A:171:CYS:HB2	2.14	0.47
1:B:300:ALA:CA	1:B:301:ALA:CB	2.92	0.47
1:A:300:ALA:CA	1:A:301:ALA:CB	2.93	0.46
1:A:266:VAL:HG12	1:A:266:VAL:O	2.15	0.46
1:B:287:ARG:O	1:B:288:MET:HE2	2.16	0.46
1:A:2:ILE:HG22	1:A:304:PRO:CD	2.46	0.45
1:A:300:ALA:CA	1:A:301:ALA:HB3	2.45	0.45
1:B:11:GLN:O	1:B:15:LYS:HB2	2.18	0.44
1:B:170:SER:O	1:B:171:CYS:HB2	2.18	0.44
1:A:259:TYR:HB3	1:A:284:TYR:CZ	2.53	0.43
1:A:263:LEU:HD21	1:A:357:LEU:HD13	1.99	0.43
1:A:354:CYS:HA	1:A:357:LEU:HD12	2.01	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:167:GLY:HA2	2:B:791:HOH:O	2.19	0.42
1:B:300:ALA:CB	1:B:301:ALA:CB	2.87	0.42
1:A:294:VAL:HG13	1:A:298:LEU:HD13	2.02	0.41
1:A:260:ASP:HA	1:A:270:THR:HG21	2.01	0.41
1:B:358:THR:HG22	1:B:358:THR:O	2.21	0.41

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:292:GLU:OE2	2:A:630:HOH:O[4_556]	1.99	0.21

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	356/359 (99%)	345 (97%)	10 (3%)	1 (0%)	36	17
1	B	356/359 (99%)	343 (96%)	12 (3%)	1 (0%)	36	17
All	All	712/718 (99%)	688 (97%)	22 (3%)	2 (0%)	36	17

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	301	ALA
1	B	301	ALA

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	287/290 (99%)	283 (99%)	4 (1%)	59	33
1	B	290/290 (100%)	287 (99%)	3 (1%)	68	45
All	All	577/580 (100%)	570 (99%)	7 (1%)	63	38

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	2	ILE
1	A	33	LEU
1	A	203	LEU
1	A	339	LEU
1	B	7	LEU
1	B	251	LEU
1	B	313	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	9	ASN
1	A	215	GLN
1	A	265	GLN
1	A	283	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

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	LLP	B	185	1	23,24,25	2.13	6 (26%)	25,32,34	1.96	8 (32%)
1	LLP	A	185	1	23,24,25	2.03	6 (26%)	25,32,34	1.90	6 (24%)

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	LLP	B	185	1	-	4/16/17/19	0/1/1/1
1	LLP	A	185	1	-	5/16/17/19	0/1/1/1

All (12) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	185	LLP	O3-C3	-5.84	1.23	1.36
1	A	185	LLP	O3-C3	-5.70	1.23	1.36
1	B	185	LLP	CE-NZ	4.21	1.56	1.46
1	A	185	LLP	CE-NZ	3.98	1.55	1.46
1	B	185	LLP	C4-C4'	3.23	1.53	1.46
1	B	185	LLP	C4'-NZ	3.14	1.37	1.27
1	A	185	LLP	C4'-NZ	2.90	1.36	1.27
1	A	185	LLP	C4-C4'	2.87	1.52	1.46
1	B	185	LLP	C2-N1	2.76	1.38	1.33
1	A	185	LLP	C2-N1	2.54	1.38	1.33
1	B	185	LLP	CD-CE	2.39	1.59	1.51
1	A	185	LLP	CD-CE	2.36	1.59	1.51

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	185	LLP	OP4-C5'-C5	5.71	120.06	109.36
1	B	185	LLP	OP4-C5'-C5	5.58	119.81	109.36
1	B	185	LLP	CD-CE-NZ	4.12	121.75	110.83
1	A	185	LLP	C4-C4'-NZ	-3.52	107.82	124.04
1	A	185	LLP	C5'-C5-C6	-3.18	114.18	119.36
1	A	185	LLP	CD-CE-NZ	3.12	119.10	110.83
1	B	185	LLP	C5'-C5-C6	-2.84	114.73	119.36
1	B	185	LLP	C4-C4'-NZ	-2.66	111.76	124.04
1	B	185	LLP	C5-C6-N1	-2.44	119.86	123.83
1	B	185	LLP	OP2-P-OP4	-2.35	100.55	106.67

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	185	LLP	OP3-P-OP4	-2.26	100.78	106.67
1	B	185	LLP	OP3-P-OP2	2.14	115.84	107.80
1	B	185	LLP	C6-C5-C4	2.12	121.85	118.21
1	A	185	LLP	C5-C6-N1	-2.08	120.44	123.83

There are no chirality outliers.

All (9) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	185	LLP	CG-CD-CE-NZ
1	B	185	LLP	C4-C4'-NZ-CE
1	A	185	LLP	C4-C4'-NZ-CE
1	A	185	LLP	C3-C4-C4'-NZ
1	A	185	LLP	CD-CE-NZ-C4'
1	B	185	LLP	CD-CE-NZ-C4'
1	B	185	LLP	C3-C4-C4'-NZ
1	B	185	LLP	CA-CB-CG-CD
1	A	185	LLP	C5-C4-C4'-NZ

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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, 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	357/359 (99%)	0.31	35 (9%) 13 13	8, 17, 40, 46	1 (0%)
1	B	358/359 (99%)	0.11	23 (6%) 25 28	9, 16, 33, 43	0
All	All	715/718 (99%)	0.21	58 (8%) 18 20	8, 16, 36, 46	1 (0%)

All (58) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	300	ALA	7.0
1	A	298	LEU	5.5
1	B	300	ALA	5.0
1	A	297	SER	4.8
1	B	5	ILE	4.7
1	B	219	TYR	4.5
1	A	293	SER	4.4
1	A	301	ALA	4.0
1	A	2	ILE	3.9
1	A	289	ASP	3.9
1	B	7	LEU	3.8
1	A	266	VAL	3.5
1	A	296	ALA	3.4
1	B	301	ALA	3.4
1	A	1	MET	3.3
1	B	290	ASN	3.3
1	A	299	LYS	3.2
1	A	358	THR	3.2
1	A	294	VAL	3.1
1	B	293	SER	3.1
1	A	303	VAL	3.0
1	B	4	PHE	3.0
1	B	269	GLY	2.9
1	B	1	MET	2.9

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Mol	Chain	Res	Type	RSRZ
1	A	347	THR	2.9
1	B	359	ASN	2.9
1	B	218	ARG	2.8
1	A	348	ALA	2.8
1	B	2	ILE	2.7
1	A	302	GLY	2.6
1	A	5	ILE	2.5
1	B	298	LEU	2.5
1	A	88	THR	2.5
1	A	355	ALA	2.5
1	A	275	VAL	2.5
1	A	356	ALA	2.4
1	A	4	PHE	2.4
1	A	354	CYS	2.4
1	A	290	ASN	2.4
1	A	292	GLU	2.4
1	A	357	LEU	2.4
1	A	6	ASP	2.3
1	A	288	MET	2.3
1	B	292	GLU	2.3
1	A	9	ASN	2.3
1	B	322	GLU	2.2
1	A	7	LEU	2.2
1	A	352	ILE	2.2
1	B	299	LYS	2.2
1	B	351	LYS	2.2
1	B	296	ALA	2.1
1	B	358	THR	2.1
1	A	353	ILE	2.1
1	B	27	ARG	2.1
1	A	265	GLN	2.1
1	B	12	ALA	2.0
1	B	320	ALA	2.0
1	A	219	TYR	2.0

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, 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
1	LLP	A	185	24/25	0.93	0.10	10,15,20,22	0
1	LLP	B	185	24/25	0.94	0.09	11,15,20,23	0

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.