



# Full wwPDB X-ray Structure Validation Report ⓘ

Sep 18, 2025 – 10:12 AM EDT

PDB ID : 9YB6 / pdb\_00009yb6  
Title : Human Mitochondrial Aspartate Aminotransferase complex with PLP at 1.5 Angstrom.  
Authors : Krinkel, B.A.; Yosaatmadja, Y.; Squire, C.J.; Loomes, K.M.  
Deposited on : 2025-09-16  
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](mailto: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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0rc1  
Mogul : 2022.3.0, CSD as543be (2022)  
Xtriage (Phenix) : 2.0rc1  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.006 (Gargrove)  
Density-Fitness : 1.0.12  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.45.1

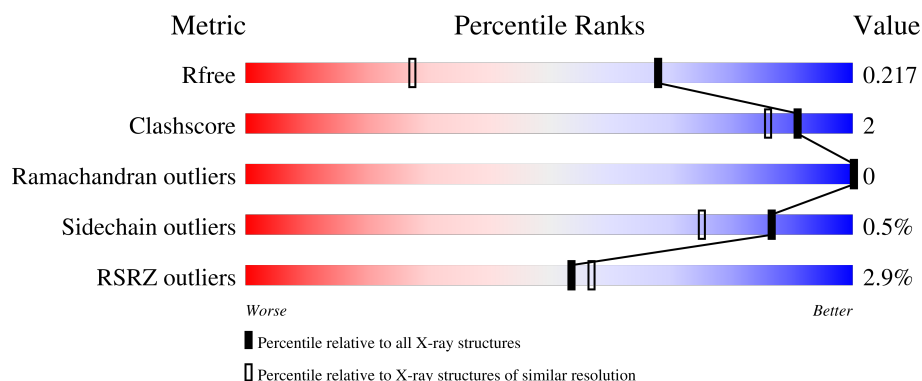
# 1 Overall quality at a glance

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))
$R_{free}$	164625	3717 (1.50-1.50)
Clashscore	180529	4048 (1.50-1.50)
Ramachandran outliers	177936	3970 (1.50-1.50)
Sidechain outliers	177891	3967 (1.50-1.50)
RSRZ outliers	164620	3718 (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  $\geq 3$ , 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	430	
1	B	430	

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 7496 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 Aspartate aminotransferase, mitochondrial.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	401	Total	C	N	O	P	S	0	9	0
			3211	2037	558	594	1	21			
1	B	404	Total	C	N	O	P	S	0	10	0
			3253	2062	567	602	1	21			

There are 6 discrepancies between the modelled and reference sequences:

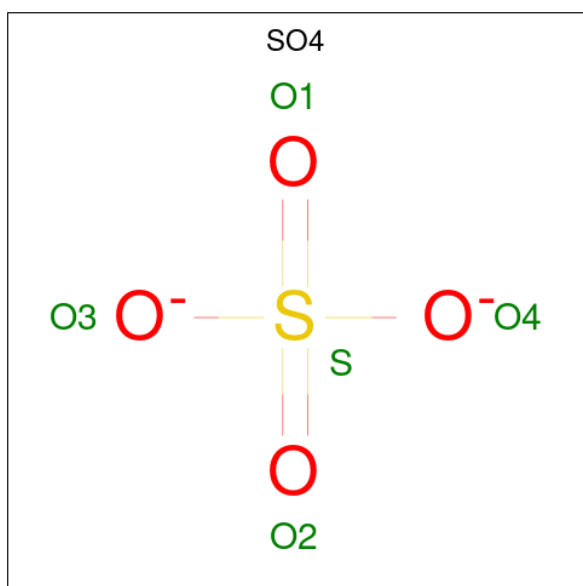
Chain	Residue	Modelled	Actual	Comment	Reference
A	27	MET	ALA	conflict	UNP P00505
A	28	ASP	ARG	conflict	UNP P00505
A	29	MET	ALA	conflict	UNP P00505
B	27	MET	ALA	conflict	UNP P00505
B	28	ASP	ARG	conflict	UNP P00505
B	29	MET	ALA	conflict	UNP P00505

- Molecule 2 is GLYCEROL (CCD ID: GOL) (formula:  $C_3H_8O_3$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		
2	B	1	Total	C	O	0	0
			6	3	3		

- Molecule 3 is SULFATE ION (CCD ID: SO4) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	O	S	0	0
			5	4	1		
3	B	1	Total	O	S	0	0
			5	4	1		

- Molecule 4 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

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

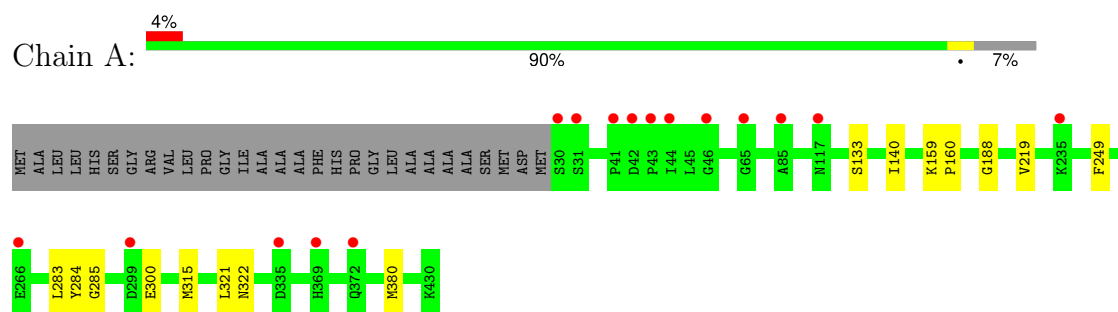
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	523	Total 523	O 523	0	0
5	B	468	Total 468	O 468	0	0

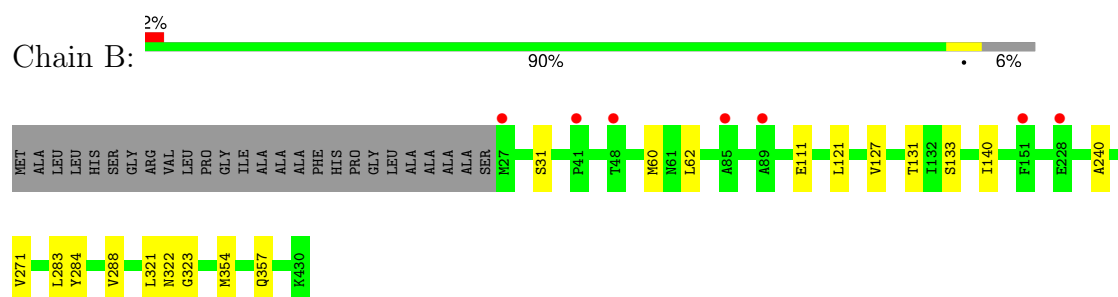
### 3 Residue-property plots [i](#)

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: Aspartate aminotransferase, mitochondrial



- Molecule 1: Aspartate aminotransferase, mitochondrial



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	57.18Å 59.17Å 67.17Å 101.39° 101.72° 95.41°	Depositor
Resolution (Å)	48.52 – 1.50 48.52 – 1.50	Depositor EDS
% Data completeness (in resolution range)	96.8 (48.52-1.50) 96.8 (48.52-1.50)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.02 (at 1.50Å)	Xtriage
Refinement program	REFMAC 5.8.0425	Depositor
R, $R_{free}$	0.185 , 0.209 0.194 , 0.217	Depositor DCC
$R_{free}$ test set	6315 reflections (4.71%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	16.7	Xtriage
Anisotropy	0.032	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 33.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.007 for -k,-h,-l	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	7496	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	20.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.02% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>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: LLP, CL, GOL, SO4

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	0.45	0/3259	0.82	0/4406
1	B	0.45	0/3301	0.83	0/4461
All	All	0.45	0/6560	0.82	0/8867

There are no bond length outliers.

There are no bond angle outliers.

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	3211	0	3156	11	0
1	B	3253	0	3201	12	0
2	A	24	0	32	0	0
2	B	6	0	8	0	0
3	A	5	0	0	0	0
3	B	5	0	0	0	0
4	B	1	0	0	0	0
5	A	523	0	0	0	0
5	B	468	0	0	1	0
All	All	7496	0	6397	21	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 2.

All (21) 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:321[B]:LEU:HD12	1:B:322:ASN:N	2.23	0.54
1:A:300:GLU:OE1	1:B:31:SER:OG	2.20	0.53
1:B:283:LEU:O	1:B:284:TYR:C	2.58	0.47
1:B:131:THR:HG22	1:B:140[B]:ILE:HD12	1.99	0.45
1:B:240:ALA:HB3	1:B:271:VAL:HG12	2.00	0.44
1:B:111:GLU:HA	1:B:121:LEU:HD11	2.00	0.43
1:A:321[A]:LEU:HD23	1:A:322:ASN:N	2.33	0.43
1:A:315[B]:MET:HE2	1:A:315[B]:MET:HB3	1.90	0.43
1:A:283:LEU:O	1:A:284:TYR:C	2.61	0.43
1:B:288:VAL:CG2	1:B:323:GLY:HA3	2.49	0.43
1:A:285:GLY:HA3	1:B:321[B]:LEU:HD23	2.02	0.42
1:A:159:LYS:HA	1:A:160:PRO:HA	1.88	0.42
1:A:249:PHE:CZ	1:A:380[B]:MET:HE3	2.55	0.42
1:B:60:MET:HE2	1:B:62:LEU:HD21	2.03	0.41
1:B:354:MET:HE2	1:B:354:MET:HA	2.02	0.41
1:B:288:VAL:HG22	1:B:323:GLY:HA3	2.02	0.40
1:A:140:ILE:HD13	1:A:315[A]:MET:HE1	2.02	0.40
1:A:249:PHE:HZ	1:A:380[B]:MET:HE3	1.84	0.40
1:B:357[B]:GLN:NE2	5:B:604:HOH:O	2.53	0.40
1:A:188:GLY:C	1:A:219:VAL:HG11	2.47	0.40
1:A:380[B]:MET:HB2	1:A:380[B]:MET:HE2	1.84	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles ⓘ

### 5.3.1 Protein backbone ⓘ

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	407/430 (95%)	396 (97%)	11 (3%)	0	100 100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	411/430 (96%)	402 (98%)	9 (2%)	0	100	100
All	All	818/860 (95%)	798 (98%)	20 (2%)	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	338/351 (96%)	337 (100%)	1 (0%)	91	82
1	B	343/351 (98%)	341 (99%)	2 (1%)	84	70
All	All	681/702 (97%)	678 (100%)	3 (0%)	86	79

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

Mol	Chain	Res	Type
1	A	133	SER
1	B	127	VAL
1	B	133	SER

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	318	ASN
1	A	427	GLN
1	B	91	ASN
1	B	318	ASN

### 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	A	279	1	23,24,25	0.47	0	25,32,34	0.67	0
1	LLP	B	279	1	23,24,25	0.46	0	25,32,34	0.63	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	LLP	A	279	1	-	4/16/17/19	0/1/1/1
1	LLP	B	279	1	-	3/16/17/19	0/1/1/1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (7) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	279	LLP	C5'-OP4-P-OP2
1	A	279	LLP	CG-CD-CE-NZ
1	B	279	LLP	CG-CD-CE-NZ
1	A	279	LLP	CA-CB-CG-CD
1	B	279	LLP	CA-CB-CG-CD
1	A	279	LLP	C5'-OP4-P-OP3
1	B	279	LLP	C5'-OP4-P-OP2

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](#)

Of 8 ligands modelled in this entry, 1 is monoatomic - leaving 7 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	$\# Z  > 2$
2	GOL	A	501	-	5,5,5	0.11	0	5,5,5	0.31	0
2	GOL	B	501	-	5,5,5	0.09	0	5,5,5	0.27	0
2	GOL	A	502	-	5,5,5	0.09	0	5,5,5	0.30	0
3	SO4	A	505	-	4,4,4	0.34	0	6,6,6	0.07	0
2	GOL	A	503	-	5,5,5	0.08	0	5,5,5	0.29	0
2	GOL	A	504	-	5,5,5	0.11	0	5,5,5	0.30	0
3	SO4	B	502	-	4,4,4	0.34	0	6,6,6	0.08	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	GOL	A	501	-	-	2/4/4/4	-
2	GOL	B	501	-	-	0/4/4/4	-
2	GOL	A	502	-	-	2/4/4/4	-
2	GOL	A	503	-	-	1/4/4/4	-
2	GOL	A	504	-	-	2/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (7) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	501	GOL	O1-C1-C2-C3
2	A	501	GOL	O1-C1-C2-O2
2	A	502	GOL	O1-C1-C2-C3
2	A	504	GOL	O1-C1-C2-C3
2	A	502	GOL	O1-C1-C2-O2
2	A	504	GOL	O1-C1-C2-O2
2	A	503	GOL	C1-C2-C3-O3

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<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	400/430 (93%)	0.20	16 (4%) 43 46	7, 18, 28, 41	9 (2%)
1	B	403/430 (93%)	0.25	7 (1%) 69 71	7, 18, 28, 39	10 (2%)
All	All	803/860 (93%)	0.23	23 (2%) 54 57	7, 18, 28, 41	19 (2%)

All (23) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	30	SER	3.6
1	A	44	ILE	3.5
1	A	41	PRO	3.2
1	A	117	ASN	3.0
1	B	85	ALA	2.8
1	B	27	MET	2.6
1	A	46	GLY	2.4
1	A	65	GLY	2.4
1	B	41	PRO	2.4
1	A	31	SER	2.3
1	A	335	ASP	2.3
1	A	43	PRO	2.3
1	B	228	GLU	2.3
1	A	85	ALA	2.2
1	B	48	THR	2.2
1	A	299	ASP	2.2
1	A	369	HIS	2.2
1	A	42	ASP	2.1
1	B	89	ALA	2.1
1	B	151	PHE	2.1
1	A	266	GLU	2.1
1	A	235	LYS	2.0
1	A	372	GLN	2.0

## 6.2 Non-standard residues in protein, DNA, RNA chains [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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	LLP	B	279	24/25	0.93	0.10	15,17,19,19	0
1	LLP	A	279	24/25	0.94	0.10	14,17,18,18	0

## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
2	GOL	A	501	6/6	0.62	0.20	38,38,39,39	0
3	SO4	B	502	5/5	0.74	0.12	68,69,70,70	0
3	SO4	A	505	5/5	0.80	0.15	70,70,71,71	0
2	GOL	A	502	6/6	0.81	0.15	37,39,39,39	0
4	CL	B	503	1/1	0.82	0.25	37,37,37,37	0
2	GOL	A	503	6/6	0.83	0.12	34,35,36,36	0
2	GOL	B	501	6/6	0.87	0.12	34,34,34,35	0
2	GOL	A	504	6/6	0.92	0.09	26,27,27,27	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.