W O R L D W I D E
wwPDB
PROTEIN DATA BANK

wwPDB X-ray Structure Validation Summary Report (i)

Mar 4, 2024 – 07:37 AM EST

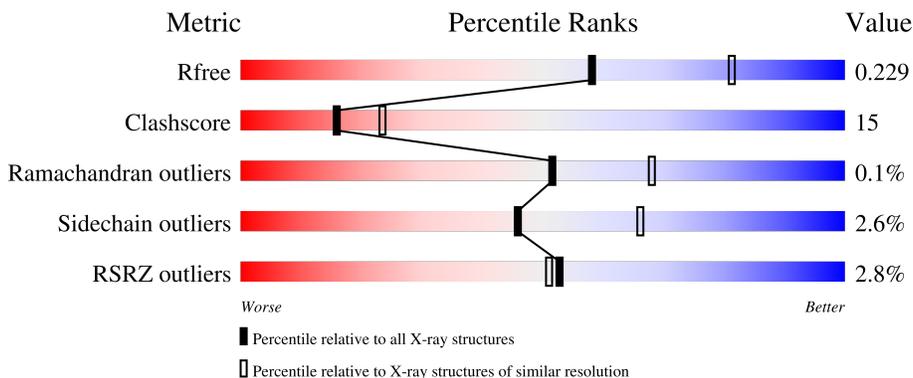|		
PDB ID	:	1D6U
Title	:	CRYSTAL STRUCTURE OF E. COLI AMINE OXIDASE ANAEROBI-CALLY REDUCED WITH BETA-PHENYLETHYLAMINE
Authors	:	Wilmot, C.M.; Hajdu, J.; McPherson, M.J.; Knowles, P.F.; Phillips, S.E.V.
Deposited on	:	1999-10-15
Resolution	:	2.40 Å(reported)

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 2.40 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	Percentile Ranks	Value
Rfree		0.229
Clashscore		15
Ramachandran outliers		0.1%
Sidechain outliers		2.6%
RSRZ outliers		2.8%

Worse   *Better*

▌ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	3907 (2.40-2.40)
Clashscore	141614	4398 (2.40-2.40)
Ramachandran outliers	138981	4318 (2.40-2.40)
Sidechain outliers	138945	4319 (2.40-2.40)
RSRZ outliers	127900	3811 (2.40-2.40)

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 <=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	727	2% / 74% / 22% / ..
1	B	727	3% / 76% / 21% / ..

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	HY1	B	3001	-	-	X	-

2 Entry composition ⓘ

There are 7 unique types of molecules in this entry. The entry contains 12855 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 COPPER AMINE OXIDASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	718	Total 5664	C 3602	N 965	O 1075	S 22	0	0	0
1	B	720	Total 5683	C 3614	N 970	O 1077	S 22	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	466	TYQ	TYR	modified residue	UNP P46883
B	466	TYQ	TYR	modified residue	UNP P46883

- Molecule 2 is COPPER (II) ION (three-letter code: CU) (formula: Cu).

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

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

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

- Molecule 4 is PHENYLACETALDEHYDE (three-letter code: HY1) (formula: C_8H_8O).

HY1
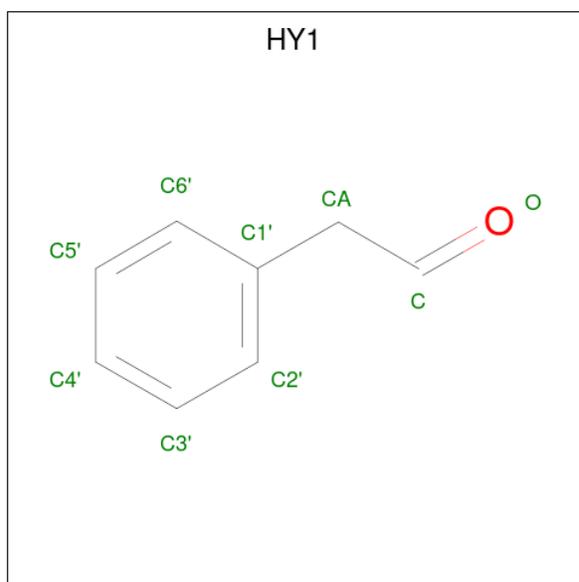
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total 9	C 8	O 1	0	0
4	B	1	Total 9	C 8	O 1	0	0

- Molecule 5 is 2-PHENYLETHYLAMINE (three-letter code: PEA) (formula: $C_8H_{12}N$).

PEA
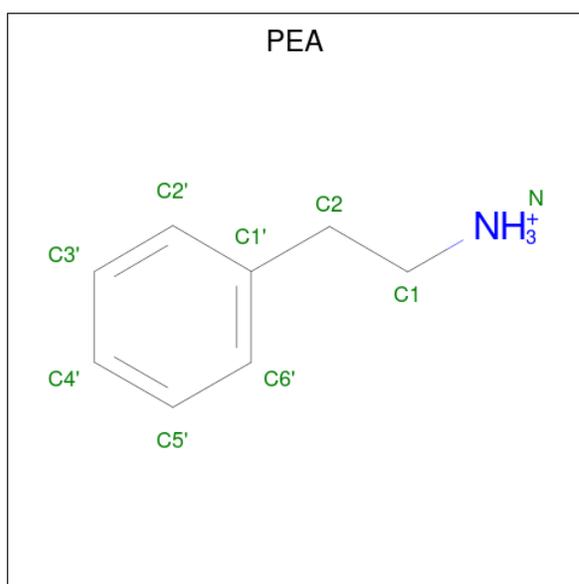
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total 9	C 8	N 1	0	0

- Molecule 6 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).

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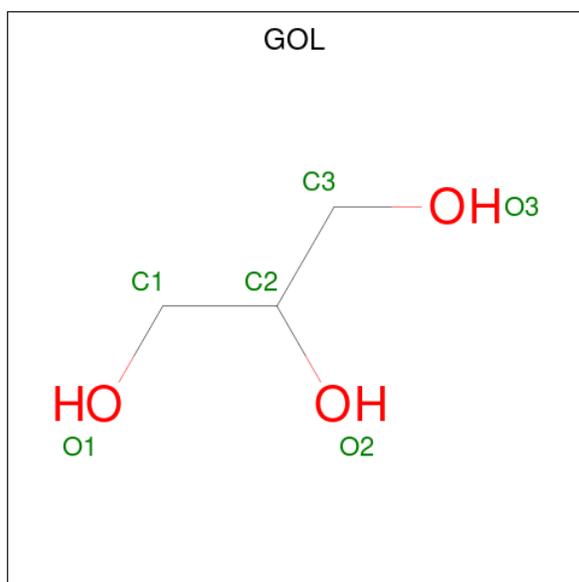
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	A	1	Total 6	C 3	O 3	0	0
6	B	1	Total 6	C 3	O 3	0	0

• Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	770	Total 770	O 770	0	0
7	B	693	Total 693	O 693	0	0

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: COPPER AMINE OXIDASE

Chain A:

• Molecule 1: COPPER AMINE OXIDASE

Chain B:

R398 P403 S404 L408 E411 F430 K439 H440 Q441 N447 W459 Y466 N477 I482 K498 E503 D516 H517 N518 I519 Q525 N540 N541 S542 L543 M546 V549 N553 T554 A555 R559 N566 N572 E573 Q574 Q578 K579 F580

D581 I585 R586 L587 L588 S589 N592 N595 R596 N599 Q604 P607 Y608 A609 G610 G611 T612 H613 K617 Q620 F621 W626 I627 Y628 H629 R630 L631 S632 F633 K636 Q637 L638 W639 V640 T641 R642 Y643 H644 R648 E651 H660 K669 D670 N671 L674

D675 N676 A679 W682 M683 T684 R692 A693 E694 E695 W696 P697 I698 M699 P700 T701 E702 T706 W711 T717 L720 K725 ASP LYS

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	135.24Å 166.48Å 79.63Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.00 – 2.40 21.61 – 2.40	Depositor EDS
% Data completeness (in resolution range)	(Not available) (30.00-2.40) 97.6 (21.61-2.40)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$<I/\sigma(I)>$ [1]	3.72 (at 2.41Å)	Xtriage
Refinement program	CNS	Depositor
R, R_{free}	0.181 , 0.239 0.177 , 0.229	Depositor DCC
R_{free} test set	2400 reflections (3.47%)	wwPDB-VP
Wilson B-factor (Å^2)	30.6	Xtriage
Anisotropy	0.729	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.36 , 70.3	EDS
L-test for twinning[2]	$<|L|> = 0.49, <L^2> = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	12855	wwPDB-VP
Average B, all atoms (Å^2)	33.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.03% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1]Intensities estimated from amplitudes.
[2]Theoretical values of $<|L|>$, $<L^2>$ 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: HY1, CU, GOL, CA, TYQ, PEA

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	0.33	0/5793	0.68	1/7886 (0.0%)
1	B	0.33	0/5813	0.66	0/7912
All	All	0.33	0/11606	0.67	1/15798 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	588	LEU	N-CA-C	-5.04	97.38	111.00

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	5664	0	5542	169	0
1	B	5683	0	5562	175	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
4	A	9	0	8	3	0
4	B	9	0	8	4	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	A	9	0	12	0	0
6	A	6	0	8	1	0
6	B	6	0	8	2	0
7	A	770	0	0	11	0
7	B	693	0	0	11	0
All	All	12855	0	11148	328	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 15.

The worst 5 of 328 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:642:ARG:HH11	1:B:642:ARG:HB2	1.14	1.08
1:B:181:LYS:N	1:B:181:LYS:HE2	1.70	1.06
1:B:181:LYS:HE2	1:B:181:LYS:H	0.91	1.05
1:A:304:LYS:H	1:B:315:ASN:HD21	1.04	0.98
1:A:227:VAL:HG12	1:A:244:LYS:HG3	1.43	0.96

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	715/727 (98%)	690 (96%)	24 (3%)	1 (0%)	51	68
1	B	717/727 (99%)	687 (96%)	30 (4%)	0	100	100
All	All	1432/1454 (98%)	1377 (96%)	54 (4%)	1 (0%)	51	68

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	277	LYS

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	609/615 (99%)	593 (97%)	16 (3%)	46	66
1	B	611/615 (99%)	595 (97%)	16 (3%)	46	66
All	All	1220/1230 (99%)	1188 (97%)	32 (3%)	46	66

5 of 32 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	642	ARG
1	B	669	LYS
1	A	613	HIS
1	A	595	ASN
1	B	671	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 65 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	572	ASN
1	B	599	ASN
1	A	572	ASN
1	A	567	GLN
1	B	604	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	TYQ	A	466	1	13,14,15	1.22	3 (23%)	15,19,21	1.17	1 (6%)
1	TYQ	B	466	1	13,14,15	1.04	2 (15%)	15,19,21	0.95	1 (6%)

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	TYQ	A	466	1	-	1/5/6/8	0/1/1/1
1	TYQ	B	466	1	-	0/5/6/8	0/1/1/1

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	466	TYQ	CE2-N5	2.58	1.46	1.37
1	B	466	TYQ	CE2-N5	2.48	1.46	1.37
1	A	466	TYQ	CE2-CZ	-2.48	1.37	1.40
1	A	466	TYQ	CD2-CE2	-2.05	1.37	1.40
1	B	466	TYQ	CE2-CZ	-2.01	1.38	1.40

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	466	TYQ	CB-CA-C	-3.36	105.17	111.47
1	B	466	TYQ	CB-CA-C	-2.51	106.75	111.47

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	466	TYQ	O-C-CA-CB

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	466	TYQ	2	0
1	B	466	TYQ	1	0

5.5 Carbohydrates ⓘ

There are no monosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 11 ligands modelled in this entry, 6 are monoatomic - leaving 5 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	$\#|Z| > 2$
6	GOL	A	2002	-	5,5,5	0.57	0	5,5,5	0.55	0
4	HY1	A	2001	-	9,9,9	1.31	1 (11%)	10,10,10	0.59	0
4	HY1	B	3001	-	9,9,9	1.23	0	10,10,10	0.69	0
5	PEA	A	2003	-	8,9,9	1.45	1 (12%)	9,10,10	0.70	0
6	GOL	B	3002	-	5,5,5	0.42	0	5,5,5	0.40	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
6	GOL	A	2002	-	-	2/4/4/4	-
4	HY1	A	2001	-	-	0/3/3/3	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	HY1	B	3001	-	-	1/3/3/3	0/1/1/1
5	PEA	A	2003	-	-	1/3/3/3	0/1/1/1
6	GOL	B	3002	-	-	0/4/4/4	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	2003	PEA	C3'-C2'	2.51	1.44	1.38
4	A	2001	HY1	C3'-C2'	2.12	1.43	1.38

There are no bond angle outliers.

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	2003	PEA	N-C1-C2-C1'
6	A	2002	GOL	C1-C2-C3-O3
6	A	2002	GOL	O2-C2-C3-O3
4	B	3001	HY1	O-C-CA-C1'

There are no ring outliers.

4 monomers are involved in 10 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	A	2002	GOL	1	0
4	A	2001	HY1	3	0
4	B	3001	HY1	4	0
6	B	3002	GOL	2	0

5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

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	717/727 (98%)	-0.40	16 (2%)	62	60	12, 28, 52, 65	0
1	B	719/727 (98%)	-0.23	24 (3%)	46	45	17, 32, 57, 70	0
All	All	1436/1454 (98%)	-0.32	40 (2%)	53	51	12, 30, 54, 70	0

The worst 5 of 40 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	6	HIS	5.7
1	A	64	LYS	5.1
1	A	12	LYS	4.3
1	B	65	ASP	4.3
1	B	302	ALA	4.1

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(Å^2)	Q<0.9
1	TYQ	A	466	14/15	0.89	0.18	24,42,53,61	0
1	TYQ	B	466	14/15	0.93	0.13	24,43,54,58	0

6.3 Carbohydrates ⓘ

There are no monosaccharides in this entry.

6.4 Ligands ⓘ

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(Å^2)	Q<0.9
6	GOL	B	3002	6/6	0.81	0.35	48,51,52,52	0
5	PEA	A	2003	9/9	0.84	0.27	32,36,39,40	0
4	HY1	A	2001	9/9	0.85	0.33	40,45,48,52	0
4	HY1	B	3001	9/9	0.91	0.17	39,41,46,55	0
3	CA	A	803	1/1	0.93	0.08	65,65,65,65	0
6	GOL	A	2002	6/6	0.94	0.21	33,42,44,51	0
3	CA	B	803	1/1	0.97	0.14	61,61,61,61	0
3	CA	A	802	1/1	0.99	0.07	20,20,20,20	0
2	CU	A	801	1/1	0.99	0.03	26,26,26,26	0
3	CA	B	802	1/1	0.99	0.11	30,30,30,30	0
2	CU	B	801	1/1	1.00	0.03	29,29,29,29	0

6.5 Other polymers ⓘ

There are no such residues in this entry.