



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 18, 2026 – 07:22 AM UTC

PDB ID : 3NRS / pdb_00003nrs
Title : Crystal structure of ligand-free bifunctional folypolyglutamate synthase/dihydrofolate synthase from yersinia pestis c092
Authors : Nocek, B.; Maltseva, N.; Makowska-grzyska, M.; Papazisi, L.; Anderson, W.; Joachimiak, A.; Center for Structural Genomics of Infectious Diseases (CS-GID)
Deposited on : 2010-06-30
Resolution : 1.80 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

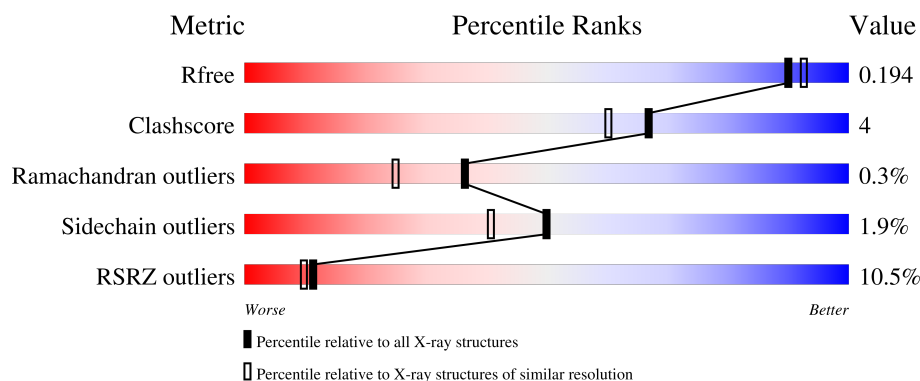
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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	7662 (1.80-1.80)
Clashscore	190562	8479 (1.80-1.80)
Ramachandran outliers	187476	8391 (1.80-1.80)
Sidechain outliers	187428	8390 (1.80-1.80)
RSRZ outliers	180081	7663 (1.80-1.80)

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	437	10% 84% 7% 8%

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
2	TLA	A	1003	X	-	-	-

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 3428 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.

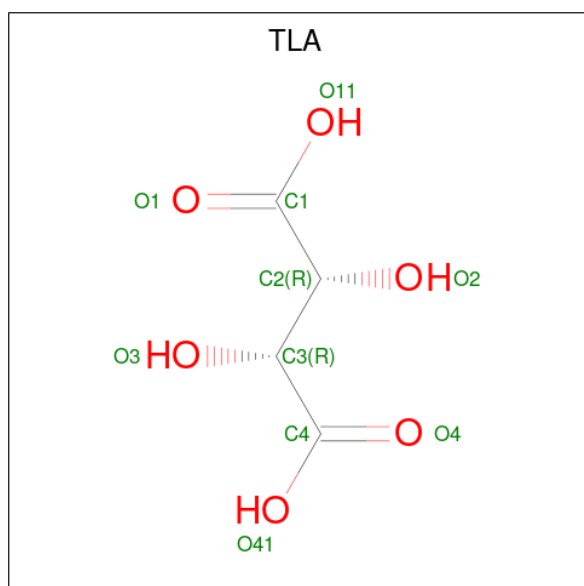
- Molecule 1 is a protein called Dihydrofolate:folylpolyglutamate synthetase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	401	3056	1928	545	572	11	0	1	0

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	SER	-	expression tag	UNP Q8D0U0
A	-1	ASN	-	expression tag	UNP Q8D0U0
A	0	ALA	-	expression tag	UNP Q8D0U0

- Molecule 2 is L(+)-TARTARIC ACID (CCD ID: TLA) (formula: C₄H₆O₆).



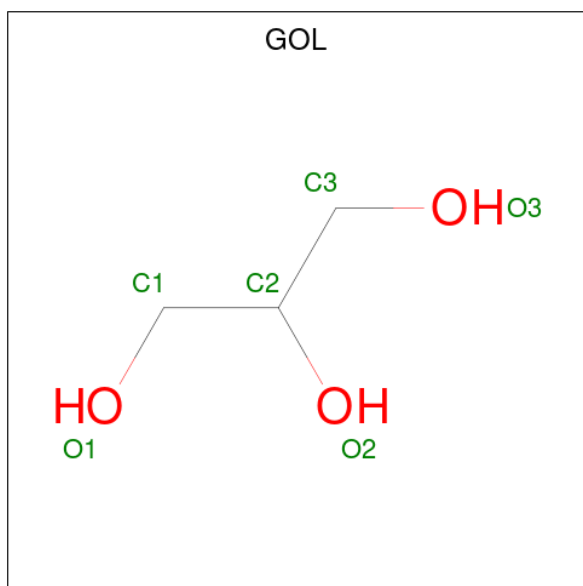
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			10	4	6		
2	A	1	Total	C	O	0	0
			10	4	6		

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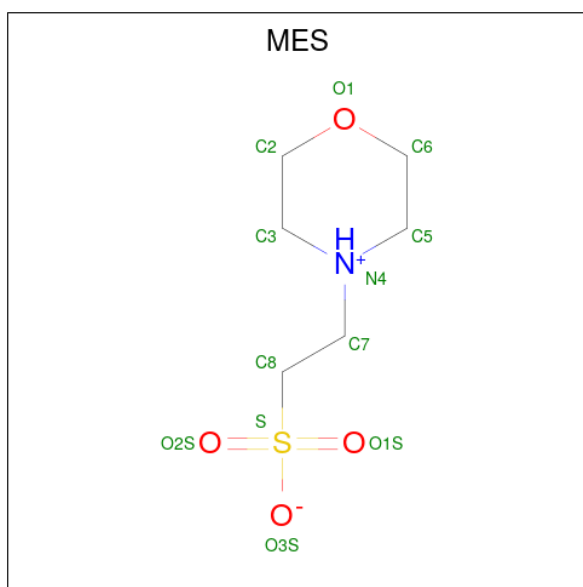
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			10	4	6		

- Molecule 3 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



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

- Molecule 4 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (CCD ID: MES) (formula: $C_6H_{13}NO_4S$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	S	0	0
			12	6	1	4	1		

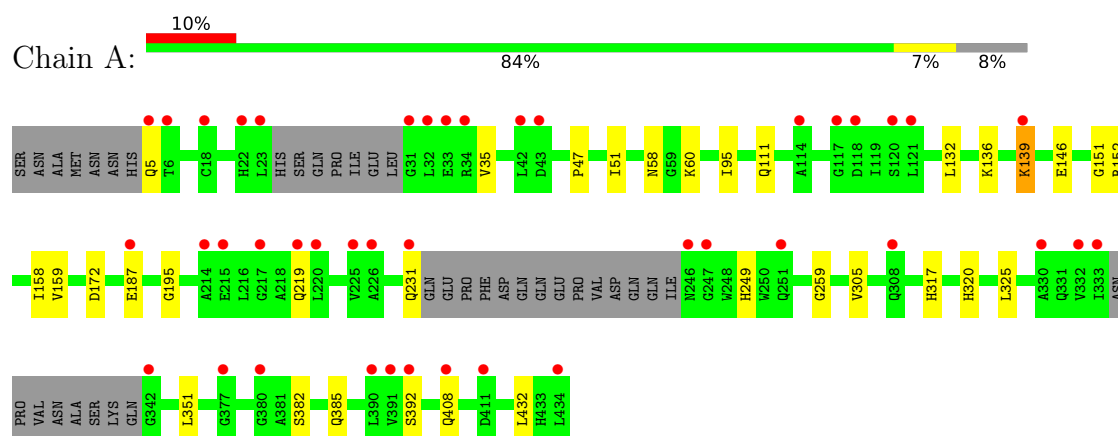
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	312	Total	O	0	0
			312	312		

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: Dihydrofolate:folylpolyglutamate synthetase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	62.63Å 83.28Å 126.74Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	40.00 – 1.80 40.00 – 1.80	Depositor EDS
% Data completeness (in resolution range)	98.6 (40.00-1.80) 98.7 (40.00-1.80)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.80 (at 1.79Å)	Xtriage
Refinement program	REFMAC 5.5.0109	Depositor
R, R_{free}	0.173 , 0.192 0.179 , 0.194	Depositor DCC
R_{free} test set	3153 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å ²)	31.6	Xtriage
Anisotropy	0.050	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 38.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	3428	wwPDB-VP
Average B, all atoms (Å ²)	37.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.10% 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: GOL, MES, TLA

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	0.92	0/3118	0.85	0/4239

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	3056	0	3036	23	0
2	A	30	0	11	4	0
3	A	18	0	24	0	0
4	A	12	0	12	1	0
5	A	312	0	0	1	0
All	All	3428	0	3083	23	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.

All (23) 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:A:58:ASN:HD22	1:A:320:HIS:CD2	2.04	0.76
1:A:58:ASN:HD22	1:A:320:HIS:HD2	1.34	0.74
1:A:317:HIS:HE1	2:A:1002:TLA:O11	1.81	0.62
1:A:139:LYS:HA	1:A:139:LYS:HZ3	1.66	0.61
1:A:351:LEU:HD11	4:A:501:MES:H81	1.85	0.58
1:A:111:GLN:NE2	5:A:459:HOH:O	2.40	0.55
1:A:382:SER:H	1:A:385:GLN:NE2	2.07	0.53
1:A:51:ILE:HD13	1:A:159:VAL:CG1	2.39	0.52
1:A:95:ILE:CG2	2:A:1003:TLA:H2	2.42	0.50
1:A:139:LYS:HA	1:A:139:LYS:NZ	2.27	0.49
1:A:152:ARG:NH2	1:A:187:GLU:OE1	2.47	0.48
1:A:195:GLY:HA2	1:A:219:GLN:HE22	1.80	0.46
1:A:35:VAL:HG13	1:A:158:ILE:HG21	1.97	0.46
1:A:317:HIS:CE1	2:A:1002:TLA:O11	2.67	0.45
1:A:172:ASP:OD1	1:A:317:HIS:HD2	2.00	0.44
1:A:136:LYS:O	1:A:139:LYS:NZ	2.50	0.44
1:A:47:PRO:HG3	1:A:132:LEU:HD22	2.00	0.43
1:A:152:ARG:HH22	1:A:187:GLU:CD	2.26	0.43
1:A:249:HIS:CD2	1:A:259:GLY:H	2.38	0.42
1:A:195:GLY:CA	1:A:219:GLN:HE22	2.33	0.42
1:A:305:VAL:HG11	1:A:432:LEU:HD13	2.01	0.41
1:A:95:ILE:HG21	2:A:1003:TLA:H2	2.04	0.40
1:A:60:LYS:HB3	1:A:146:GLU:HG3	2.03	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	394/437 (90%)	385 (98%)	8 (2%)	1 (0%)	36 25

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	151	GLY

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	317/352 (90%)	311 (98%)	6 (2%)	50 41

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	5	GLN
1	A	139	LYS
1	A	231	GLN
1	A	325	LEU
1	A	392	SER
1	A	408	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	8	GLN
1	A	219	GLN
1	A	246	ASN
1	A	249	HIS
1	A	251	GLN
1	A	256	GLN
1	A	317	HIS
1	A	320	HIS
1	A	385	GLN

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](#)

7 ligands 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$
3	GOL	A	1101	-	5,5,5	0.36	0	5,5,5	0.65	0
2	TLA	A	1003	-	9,9,9	1.32	1 (11%)	12,12,12	2.36	3 (25%)
2	TLA	A	1001	-	9,9,9	1.51	2 (22%)	12,12,12	1.53	2 (16%)
2	TLA	A	1002	-	9,9,9	1.32	0	12,12,12	0.81	0
3	GOL	A	435	-	5,5,5	0.76	0	5,5,5	0.91	0
4	MES	A	501	-	12,12,12	2.14	2 (16%)	15,16,16	2.40	7 (46%)
3	GOL	A	1100	-	5,5,5	0.93	0	5,5,5	0.43	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	GOL	A	1101	-	-	2/4/4/4	-
2	TLA	A	1003	-	1/1/4/4	5/12/12/12	-
2	TLA	A	1001	-	-	4/12/12/12	-
2	TLA	A	1002	-	-	0/12/12/12	-
3	GOL	A	435	-	-	4/4/4/4	-
4	MES	A	501	-	-	2/6/14/14	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	GOL	A	1100	-	-	4/4/4/4	-

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	501	MES	C8-S	-6.52	1.68	1.77
4	A	501	MES	O2S-S	3.17	1.54	1.45
2	A	1001	TLA	O11-C1	-2.76	1.21	1.30
2	A	1001	TLA	C3-C4	-2.21	1.49	1.52
2	A	1003	TLA	O1-C1	2.04	1.28	1.22

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1003	TLA	O3-C3-C2	5.17	120.69	110.17
4	A	501	MES	C5-N4-C3	5.16	119.95	108.84
2	A	1003	TLA	C2-C3-C4	5.12	121.18	109.82
4	A	501	MES	C7-N4-C3	4.17	122.36	111.24
4	A	501	MES	O1S-S-C8	4.15	113.00	106.73
2	A	1003	TLA	O3-C3-C4	3.14	117.41	110.69
2	A	1001	TLA	O3-C3-C4	-2.95	104.40	110.69
2	A	1001	TLA	O2-C2-C3	2.82	115.91	110.17
4	A	501	MES	C2-C3-N4	-2.64	106.10	110.12
4	A	501	MES	C7-N4-C5	2.39	117.61	111.24
4	A	501	MES	O2S-S-C8	-2.19	103.42	106.73
4	A	501	MES	C6-O1-C2	2.10	116.69	109.88

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
2	A	1003	TLA	C3

All (21) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	1003	TLA	O2-C2-C3-C4
3	A	1100	GOL	O1-C1-C2-C3
3	A	1101	GOL	O1-C1-C2-C3
4	A	501	MES	C8-C7-N4-C3
2	A	1003	TLA	C1-C2-C3-C4
2	A	1003	TLA	O3-C3-C4-O4

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Mol	Chain	Res	Type	Atoms
2	A	1003	TLA	O3-C3-C4-O41
3	A	1100	GOL	C1-C2-C3-O3
3	A	435	GOL	O1-C1-C2-C3
3	A	435	GOL	C1-C2-C3-O3
3	A	1100	GOL	O1-C1-C2-O2
3	A	1101	GOL	O1-C1-C2-O2
2	A	1001	TLA	O3-C3-C4-O41
2	A	1001	TLA	O3-C3-C4-O4
2	A	1001	TLA	C2-C3-C4-O4
3	A	435	GOL	O1-C1-C2-O2
3	A	435	GOL	O2-C2-C3-O3
4	A	501	MES	C8-C7-N4-C5
2	A	1001	TLA	C2-C3-C4-O41
3	A	1100	GOL	O2-C2-C3-O3
2	A	1003	TLA	C2-C3-C4-O4

There are no ring outliers.

3 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1003	TLA	2	0
2	A	1002	TLA	2	0
4	A	501	MES	1	0

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	401/437 (91%)	0.45	42 (10%)	11 10	20, 33, 60, 82	2 (0%)

All (42) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	333	ILE	5.7
1	A	31	GLY	5.0
1	A	392	SER	4.9
1	A	214	ALA	4.7
1	A	391	VAL	4.1
1	A	330	ALA	4.0
1	A	114	ALA	3.9
1	A	118	ASP	3.7
1	A	219	GLN	3.3
1	A	246	ASN	3.3
1	A	332	VAL	3.3
1	A	23	LEU	3.2
1	A	225	VAL	3.1
1	A	5	GLN	3.1
1	A	217	GLY	3.0
1	A	22	HIS	2.9
1	A	18	CYS	2.9
1	A	120	SER	2.9
1	A	215	GLU	2.9
1	A	33	GLU	2.8
1	A	226	ALA	2.7
1	A	342	GLY	2.6
1	A	32	LEU	2.5
1	A	117	GLY	2.5
1	A	380	GLY	2.5
1	A	34	ARG	2.5
1	A	139	LYS	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	390	LEU	2.4
1	A	251	GLN	2.4
1	A	308	GLN	2.4
1	A	121	LEU	2.4
1	A	187	GLU	2.4
1	A	377	GLY	2.3
1	A	434	LEU	2.3
1	A	43	ASP	2.3
1	A	408	GLN	2.3
1	A	42	LEU	2.3
1	A	6	THR	2.2
1	A	247	GLY	2.2
1	A	411	ASP	2.2
1	A	220	LEU	2.1
1	A	231	GLN	2.0

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($\text{\AA}^2$)	Q<0.9
2	TLA	A	1003	10/10	0.76	0.20	49,52,54,54	10
3	GOL	A	1101	6/6	0.84	0.19	76,77,77,77	0
2	TLA	A	1001	10/10	0.89	0.12	35,39,43,45	0
3	GOL	A	435	6/6	0.90	0.11	43,47,48,50	0
4	MES	A	501	12/12	0.90	0.18	39,49,56,56	0
3	GOL	A	1100	6/6	0.92	0.11	42,49,51,57	0
2	TLA	A	1002	10/10	0.93	0.11	26,36,40,41	0

6.5 Other polymers [i](#)

There are no such residues in this entry.