Full wwPDB X-ray Structure Validation Report (i)

Nov 16, 2022 – 02:10 AM EST

PDB ID	:	1L24
Title	:	ENHANCED PROTEIN THERMOSTABILITY FROM SITE-DIRECTED MUTATIONS THAT DECREASE THE ENTROPY OF UNFOLDING
Authors	:	Nicholson, H.; Matthews, B.W.
Deposited on	:	1989-05-01
Resolution	:	1.70 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 (i) 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 (1)) were used in the production of this report:

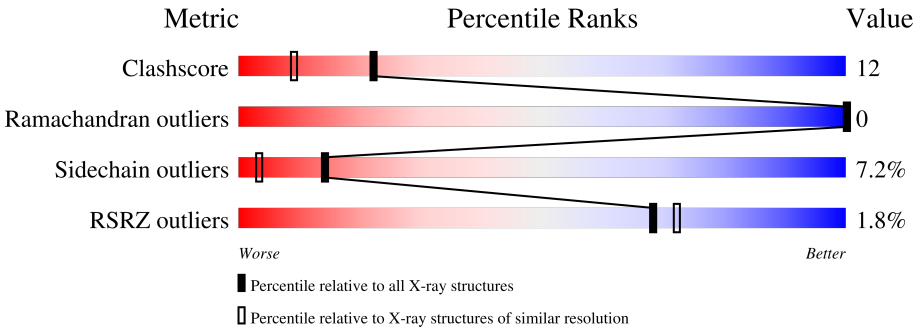
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.31.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.31.2

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

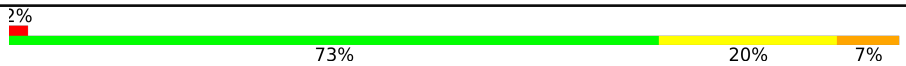
The reported resolution of this entry is 1.70 Å.

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))
Clashscore	141614	4695 (1.70-1.70)
Ramachandran outliers	138981	4610 (1.70-1.70)
Sidechain outliers	138945	4610 (1.70-1.70)
RSRZ outliers	127900	4222 (1.70-1.70)

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	164	

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 1462 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 T4 LYSOZYME.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	164	1311	825	238	241	7	0	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	82	PRO	ALA	engineered mutation	UNP P00720

- Molecule 2 is water.

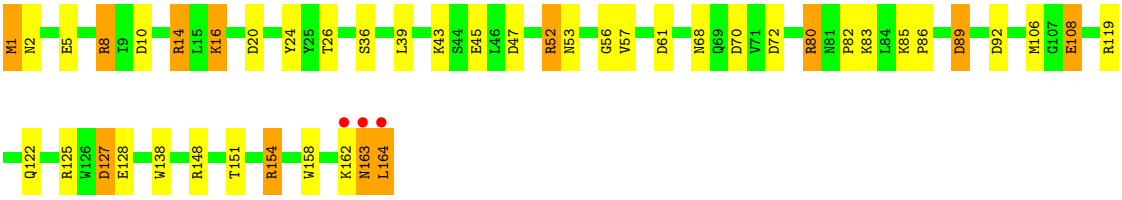
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
2	A	151	151	151	0	0

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: T4 LYSOZYME

Chain A:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α, β, γ	61.20Å 61.20Å 97.10Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	6.00 – 1.70 19.62 – 1.70	Depositor EDS
% Data completeness (in resolution range)	(Not available) (6.00-1.70) 59.7 (19.62-1.70)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.57 (at 1.70Å)	Xtriage
Refinement program	TNT	Depositor
R, R_{free}	0.158 , (Not available) 0.160 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å^2)	18.5	Xtriage
Anisotropy	0.179	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.37 , 95.8	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	0.048 for -h,-k,l	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	1462	wwPDB-VP
Average B, all atoms (Å^2)	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.22% of the height of the origin peak. No significant pseudotranslation is detected.*

[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 (i)

5.1 Standard geometry (i)

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	0.99	3/1332 (0.2%)	1.46	27/1793 (1.5%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	45	GLU	CD-OE2	6.52	1.32	1.25
1	A	128	GLU	CD-OE2	5.53	1.31	1.25
1	A	108	GLU	CD-OE2	5.22	1.31	1.25

All (27) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	80	ARG	NE-CZ-NH1	10.49	125.54	120.30
1	A	163	ASN	N-CA-CB	-9.58	93.35	110.60
1	A	47	ASP	CB-CG-OD2	-9.13	110.09	118.30
1	A	14	ARG	NE-CZ-NH1	8.83	124.72	120.30
1	A	8	ARG	NE-CZ-NH1	7.96	124.28	120.30
1	A	92	ASP	CB-CG-OD2	-7.92	111.17	118.30
1	A	47	ASP	CB-CG-OD1	7.86	125.38	118.30
1	A	80	ARG	NE-CZ-NH2	-7.82	116.39	120.30
1	A	70	ASP	CB-CG-OD1	6.60	124.24	118.30
1	A	154	ARG	NE-CZ-NH1	6.27	123.44	120.30
1	A	61	ASP	CB-CG-OD2	-6.22	112.70	118.30
1	A	72	ASP	CB-CG-OD1	6.20	123.88	118.30
1	A	52	ARG	NE-CZ-NH2	-6.12	117.24	120.30
1	A	14	ARG	NE-CZ-NH2	-6.11	117.25	120.30
1	A	20	ASP	CB-CG-OD1	6.09	123.78	118.30
1	A	163	ASN	CB-CA-C	-5.68	99.04	110.40
1	A	92	ASP	CB-CG-OD1	5.68	123.41	118.30
1	A	154	ARG	NE-CZ-NH2	-5.65	117.48	120.30
1	A	127	ASP	CB-CG-OD1	5.59	123.33	118.30
1	A	89	ASP	CB-CG-OD2	-5.43	113.42	118.30
1	A	10	ASP	CB-CG-OD2	-5.38	113.45	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	10	ASP	CB-CG-OD1	5.31	123.08	118.30
1	A	119	ARG	NE-CZ-NH1	5.29	122.94	120.30
1	A	14	ARG	CD-NE-CZ	5.24	130.94	123.60
1	A	26	THR	CA-CB-CG2	5.24	119.74	112.40
1	A	127	ASP	CB-CG-OD2	-5.18	113.64	118.30
1	A	24	TYR	CB-CG-CD1	-5.03	117.98	121.00

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts (i)

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	1311	0	1336	31	0
2	A	151	0	0	6	0
All	All	1462	0	1336	31	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 12.

All (31) 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:163:ASN:HB3	1:A:164:LEU:HD13	1.28	1.12
1:A:163:ASN:CB	1:A:164:LEU:HD13	2.01	0.89
1:A:52:ARG:HH11	1:A:52:ARG:HG3	1.49	0.78
1:A:14:ARG:HG3	2:A:532:HOH:O	1.86	0.74
1:A:16:LYS:HE3	1:A:57:VAL:HG23	1.71	0.73
1:A:148:ARG:HD3	1:A:164:LEU:HD21	1.75	0.69
1:A:163:ASN:HB3	1:A:164:LEU:CD1	2.16	0.67
1:A:80:ARG:NH2	2:A:277:HOH:O	2.28	0.66
1:A:16:LYS:HE3	1:A:57:VAL:CG2	2.27	0.64
1:A:148:ARG:HD3	1:A:164:LEU:CD2	2.28	0.64
1:A:16:LYS:HD2	1:A:57:VAL:HG22	1.85	0.58
1:A:108:GLU:HB2	2:A:316:HOH:O	2.03	0.58

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:52:ARG:HG3	1:A:52:ARG:NH1	2.19	0.55
1:A:1:MET:HG3	1:A:2:ASN:N	2.27	0.49
1:A:158:TRP:HB2	1:A:162:LYS:HE3	1.95	0.47
1:A:164:LEU:CD1	1:A:164:LEU:N	2.77	0.47
1:A:16:LYS:HE2	1:A:56:GLY:O	2.14	0.47
1:A:8:ARG:NH1	2:A:247:HOH:O	2.48	0.46
1:A:1:MET:HG2	1:A:158:TRP:CE3	2.52	0.45
1:A:85:LYS:NZ	1:A:89:ASP:OD1	2.49	0.45
1:A:39:LEU:HG	1:A:43:LYS:HD2	1.99	0.44
1:A:164:LEU:HD13	1:A:164:LEU:N	2.33	0.44
1:A:151:THR:HG22	2:A:543:HOH:O	2.18	0.44
1:A:52:ARG:NH1	1:A:52:ARG:CG	2.80	0.44
1:A:1:MET:HA	1:A:5:GLU:OE1	2.18	0.43
1:A:16:LYS:CE	1:A:57:VAL:CG2	2.96	0.43
1:A:125:ARG:HH11	1:A:125:ARG:HD3	1.62	0.41
1:A:68:ASN:HD22	1:A:68:ASN:HA	1.73	0.40
1:A:68:ASN:ND2	2:A:185:HOH:O	2.54	0.40
1:A:85:LYS:N	1:A:86:PRO:CD	2.84	0.40
1:A:106:MET:CE	1:A:138:TRP:CD1	3.04	0.40

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	162/164 (99%)	158 (98%)	4 (2%)	0	100 100

There are no Ramachandran outliers to report.

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	139/139 (100%)	129 (93%)	10 (7%)	14 3

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	16	LYS
1	A	36	SER
1	A	53	ASN
1	A	82	PRO
1	A	83	LYS
1	A	122	GLN
1	A	127	ASP
1	A	154	ARG
1	A	164	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	68	ASN
1	A	144	ASN
1	A	163	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 monosaccharides 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 (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	164/164 (100%)	-0.50	3 (1%) 68 72	12, 22, 46, 69	0

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	164	LEU	9.0
1	A	163	ASN	3.7
1	A	162	LYS	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 monosaccharides 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.