



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 03:48 AM UTC

PDB ID : 1RAT / pdb_00001rat
Title : EFFECTS OF TEMPERATURE ON PROTEIN STRUCTURE AND DYNAMICS: X-RAY CRYSTALLOGRAPHIC STUDIES OF THE PROTEIN RIBONUCLEASE-A AT NINE DIFFERENT TEMPERATURES FROM 98 TO 320 K
Authors : Tiltonjunior, R.F.; Dewan, J.C.; Petsko, G.A.
Deposited on : 1991-08-13
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
Xtriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

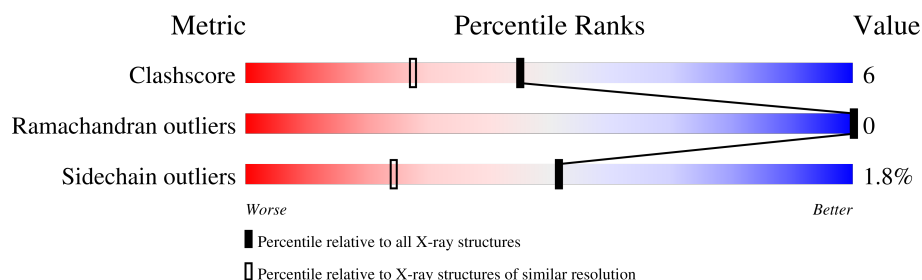
1 Overall quality at a glance

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))
Clashscore	190562	4235 (1.50-1.50)
Ramachandran outliers	187476	4153 (1.50-1.50)
Sidechain outliers	187428	4150 (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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	124	

2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 951 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 RIBONUCLEASE A.

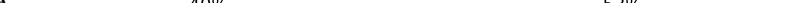
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	124	951	575	171	193	12	0	0	0

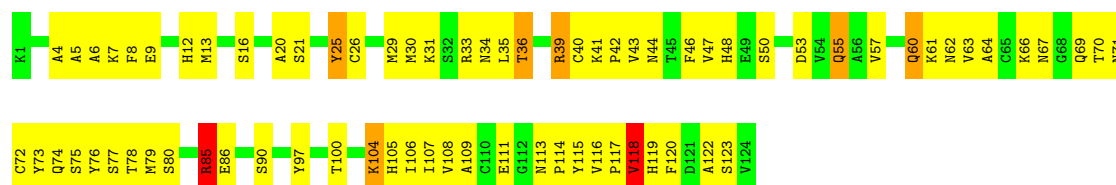
3 Residue-property plots

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. 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. 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.

Note EDS was not executed.

- Molecule 1: RIBONUCLEASE A

Chain A:  40% 53% 5%



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	29.48Å 38.08Å 52.97Å 90.00° 106.09° 90.00°	Depositor
Resolution (Å)	(Not available) – 1.50	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-1.50)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROLSQ	Depositor
R, R_{free}	0.171 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	951	wwPDB-VP
Average B, all atoms (Å ²)	6.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

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	2.29	38/967 (3.9%)	2.65	80/1304 (6.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

All (38) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	119	HIS	CE1-NE2	9.91	1.42	1.32
1	A	116	VAL	N-CA	8.90	1.54	1.46
1	A	12	HIS	CA-CB	8.34	1.66	1.54
1	A	6	ALA	N-CA	8.18	1.56	1.46
1	A	48	HIS	CG-CD2	8.12	1.44	1.35
1	A	47	VAL	CA-C	8.02	1.62	1.52
1	A	13	MET	CG-SD	-7.66	1.61	1.80
1	A	69	GLN	N-CA	6.87	1.54	1.46
1	A	71	ASN	N-CA	6.64	1.54	1.46
1	A	73	TYR	CA-CB	6.59	1.65	1.53
1	A	120	PHE	CA-CB	6.56	1.61	1.53
1	A	114	PRO	N-CD	6.45	1.56	1.47
1	A	39	ARG	C-O	6.42	1.31	1.23
1	A	61	LYS	CA-C	-6.27	1.45	1.52
1	A	21	SER	N-CA	6.13	1.54	1.46
1	A	122	ALA	CA-CB	6.03	1.63	1.53
1	A	73	TYR	C-N	-6.03	1.25	1.33
1	A	55	GLN	C-O	6.02	1.31	1.24
1	A	85	ARG	N-CA	5.82	1.53	1.46
1	A	90	SER	C-N	-5.82	1.26	1.33

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	90	SER	C-O	5.67	1.30	1.23
1	A	7	LYS	CA-C	-5.64	1.45	1.52
1	A	97	TYR	CA-CB	5.59	1.65	1.54
1	A	77	SER	CA-CB	5.55	1.62	1.53
1	A	16	SER	N-CA	5.55	1.53	1.46
1	A	106	ILE	CA-C	5.49	1.59	1.52
1	A	46	PHE	N-CA	5.47	1.52	1.46
1	A	119	HIS	CA-C	-5.38	1.45	1.52
1	A	25	TYR	N-CA	5.32	1.52	1.46
1	A	48	HIS	CB-CG	-5.30	1.42	1.50
1	A	35	LEU	C-O	5.24	1.30	1.24
1	A	30	MET	CA-C	-5.21	1.46	1.52
1	A	115	TYR	C-N	-5.20	1.28	1.33
1	A	62	ASN	C-N	-5.17	1.28	1.33
1	A	8	PHE	C-N	5.10	1.40	1.33
1	A	53	ASP	C-N	-5.08	1.27	1.33
1	A	107	ILE	CB-CG1	-5.07	1.43	1.53
1	A	80	SER	N-CA	5.04	1.52	1.46

All (80) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	47	VAL	O-C-N	13.05	138.37	123.10
1	A	7	LYS	O-C-N	-10.23	111.28	122.12
1	A	20	ALA	O-C-N	10.16	134.93	123.04
1	A	73	TYR	O-C-N	9.80	134.88	123.41
1	A	108	VAL	O-C-N	9.71	133.39	123.00
1	A	33	ARG	NE-CZ-NH2	9.22	127.50	119.20
1	A	63	VAL	CA-C-O	9.04	128.55	120.96
1	A	55	GLN	OE1-CD-NE2	8.82	131.42	122.60
1	A	116	VAL	N-CA-CB	-8.80	104.19	111.67
1	A	47	VAL	CA-C-O	-8.71	111.21	120.53
1	A	31	LYS	O-C-N	8.56	131.34	122.09
1	A	118	VAL	N-CA-CB	-8.38	97.40	111.23
1	A	12	HIS	N-CA-C	8.20	125.52	114.12
1	A	64	ALA	O-C-N	8.20	132.63	123.04
1	A	44	ASN	CA-CB-CG	-8.02	104.58	112.60
1	A	50	SER	CA-C-O	-7.87	112.74	121.87
1	A	50	SER	O-C-N	7.81	131.70	122.79
1	A	9	GLU	O-C-N	7.75	130.46	122.09
1	A	113	ASN	CA-CB-CG	-7.75	104.85	112.60
1	A	31	LYS	CA-C-O	-7.45	113.03	120.70

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	7	LYS	CA-C-N	7.29	130.38	120.54
1	A	7	LYS	C-N-CA	7.29	130.38	120.54
1	A	5	ALA	O-C-N	7.27	129.94	122.09
1	A	97	TYR	N-CA-C	7.16	120.32	109.23
1	A	8	PHE	CA-C-O	7.07	128.47	120.90
1	A	9	GLU	CA-C-O	-7.01	113.48	120.70
1	A	115	TYR	O-C-N	6.87	131.75	122.82
1	A	80	SER	CA-C-O	6.86	128.51	120.69
1	A	53	ASP	O-C-N	6.80	129.33	122.12
1	A	119	HIS	O-C-N	-6.77	115.76	123.48
1	A	70	THR	O-C-N	6.62	130.28	122.34
1	A	13	MET	O-C-N	6.59	130.90	123.19
1	A	66	LYS	CA-C-O	-6.57	113.87	120.90
1	A	12	HIS	CA-CB-CG	-6.54	107.25	113.80
1	A	36	THR	CA-C-O	6.48	126.35	119.03
1	A	12	HIS	ND1-CE1-NE2	6.46	114.86	108.40
1	A	41	LYS	O-C-N	-6.45	115.70	121.31
1	A	73	TYR	CA-C-O	-6.42	112.65	120.54
1	A	90	SER	CA-C-O	-6.27	113.77	120.92
1	A	118	VAL	CB-CA-C	6.27	121.57	111.29
1	A	69	GLN	CA-C-O	6.26	128.18	121.55
1	A	109	ALA	N-CA-CB	6.24	120.46	110.16
1	A	5	ALA	CA-C-O	-6.17	114.35	120.70
1	A	100	THR	O-C-N	6.16	130.48	123.27
1	A	74	GLN	OE1-CD-NE2	6.11	128.71	122.60
1	A	46	PHE	CA-C-O	6.10	126.95	120.36
1	A	60	GLN	OE1-CD-NE2	-6.07	116.53	122.60
1	A	119	HIS	CA-C-O	6.06	127.58	120.43
1	A	20	ALA	CA-C-N	-6.06	111.00	121.66
1	A	20	ALA	C-N-CA	-6.06	111.00	121.66
1	A	107	ILE	CB-CG1-CD1	6.05	126.51	113.80
1	A	42	PRO	N-CA-C	5.96	121.81	113.53
1	A	78	THR	N-CA-C	-5.82	102.84	110.53
1	A	62	ASN	CB-CG-OD1	-5.79	109.22	120.80
1	A	40	CYS	N-CA-CB	5.66	118.45	110.24
1	A	70	THR	CA-C-N	-5.66	113.56	122.95
1	A	70	THR	C-N-CA	-5.66	113.56	122.95
1	A	120	PHE	O-C-N	5.66	129.78	123.05
1	A	86	GLU	CA-C-O	5.65	127.55	121.44
1	A	67	ASN	CA-C-O	-5.61	109.94	118.91
1	A	119	HIS	ND1-CG-CD2	5.60	111.70	106.10
1	A	26	CYS	O-C-N	-5.58	116.21	122.12

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	34	ASN	CA-C-O	-5.51	113.96	120.57
1	A	71	ASN	CB-CG-ND2	5.47	124.60	116.40
1	A	12	HIS	CE1-NE2-CD2	-5.44	103.56	109.00
1	A	79	MET	O-C-N	5.36	129.48	123.27
1	A	72	CYS	O-C-N	-5.33	116.97	123.10
1	A	67	ASN	O-C-N	5.30	130.89	122.41
1	A	57	VAL	O-C-N	5.24	127.17	121.87
1	A	13	MET	CA-C-O	-5.24	114.99	120.80
1	A	105	HIS	CA-C-O	-5.18	115.91	121.56
1	A	36	THR	CA-C-N	5.13	127.93	120.79
1	A	36	THR	C-N-CA	5.13	127.93	120.79
1	A	36	THR	CA-CB-OG1	-5.12	101.92	109.60
1	A	60	GLN	CG-CD-OE1	5.11	131.01	120.80
1	A	75	SER	O-C-N	-5.10	116.60	122.87
1	A	85	ARG	CA-C-O	-5.10	114.01	120.28
1	A	8	PHE	CA-CB-CG	-5.08	108.72	113.80
1	A	66	LYS	O-C-N	5.06	127.35	122.09
1	A	25	TYR	O-C-N	5.01	127.44	122.08

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	85	ARG	Sidechain

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	951	0	905	11	0
All	All	951	0	905	11	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 6.

All (11) 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:43:VAL:HG22	1:A:85:ARG:HG2	1.88	0.54
1:A:4:ALA:CB	1:A:118:VAL:HG22	2.42	0.50
1:A:104:LYS:HD3	1:A:123:SER:OG	2.14	0.47
1:A:4:ALA:HB3	1:A:118:VAL:HG22	1.97	0.46
1:A:104:LYS:HD3	1:A:123:SER:CB	2.47	0.44
1:A:25:TYR:CZ	1:A:29:MET:HG3	2.52	0.44
1:A:60:GLN:HG2	1:A:76:TYR:CE2	2.53	0.44
1:A:104:LYS:HD3	1:A:123:SER:HB2	1.99	0.42
1:A:36:THR:HA	1:A:39:ARG:O	2.20	0.41
1:A:111:GLU:HG3	1:A:118:VAL:HG11	2.03	0.40
1:A:55:GLN:HA	1:A:117:PRO:HD3	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	122/124 (98%)	116 (95%)	6 (5%)	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	109/109 (100%)	107 (98%)	2 (2%)	51	24

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	104	LYS
1	A	118	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	11	GLN
1	A	28	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](#)

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

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.