



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 07:49 AM UTC

PDB ID : 4QJF / pdb_00004qjf
Title : X-ray crystal structure of Thermococcus kodakarensis RNA polymerase Rpp4/Rpo7 (RpoF/RpoE) complex
Authors : Murakami, K.S.
Deposited on : 2014-06-03
Resolution : 2.31 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)	:	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

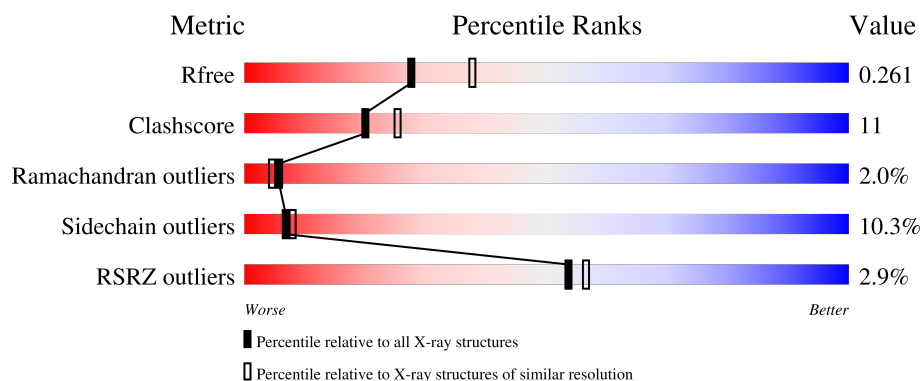
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.31 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	7754 (2.34-2.30)
Clashscore	190562	8383 (2.34-2.30)
Ramachandran outliers	187476	8303 (2.34-2.30)
Sidechain outliers	187428	8303 (2.34-2.30)
RSRZ outliers	180081	7760 (2.34-2.30)

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	190	2% 68% 24% 5% ..
2	B	122	5% 70% 24% 6%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2664 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 DNA-directed RNA polymerase, subunit E'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	186	Total	C	N	O	S	0	0	0
			1506	964	257	276	9			

- Molecule 2 is a protein called DNA-directed RNA polymerase, subunit F.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	122	Total	C	N	O	S	0	0	0
			1021	654	169	194	4			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	115	ILE	-	expression tag	UNP Q5JI52
B	116	ASP	-	expression tag	UNP Q5JI52
B	117	GLU	-	expression tag	UNP Q5JI52
B	118	TYR	-	expression tag	UNP Q5JI52
B	119	ARG	-	expression tag	UNP Q5JI52
B	120	PRO	-	expression tag	UNP Q5JI52
B	121	LEU	-	expression tag	UNP Q5JI52
B	122	GLU	-	expression tag	UNP Q5JI52

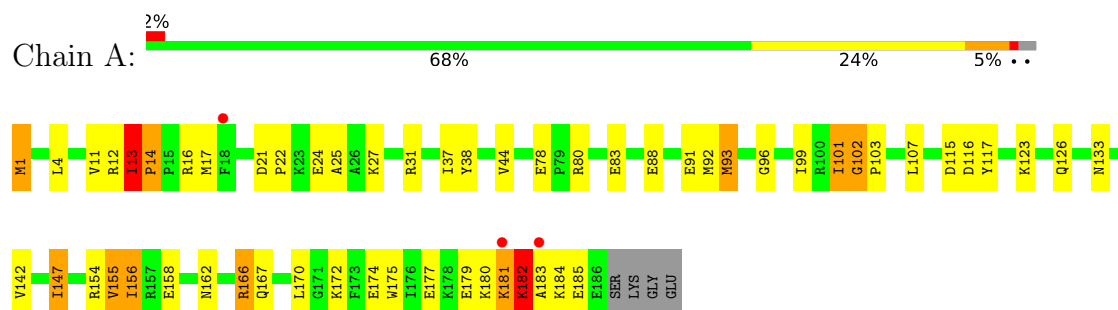
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	71	Total	O	0	0
			71	71		
3	B	66	Total	O	0	0
			66	66		

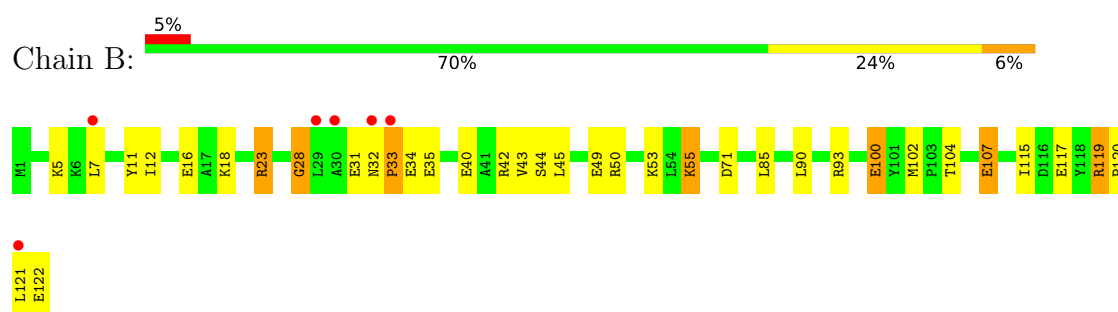
3 Residue-property plots [i](#)

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: DNA-directed RNA polymerase, subunit E'



- Molecule 2: DNA-directed RNA polymerase, subunit F



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	42.47Å 80.94Å 97.41Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	25.79 – 2.31 25.79 – 2.31	Depositor EDS
% Data completeness (in resolution range)	86.6 (25.79-2.31) 86.6 (25.79-2.31)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.55 (at 2.31Å)	Xtriage
Refinement program	PHENIX (phenix.refine: dev_1626)	Depositor
R, R_{free}	0.193 , 0.261 0.196 , 0.261	Depositor DCC
R_{free} test set	673 reflections (4.40%)	wwPDB-VP
Wilson B-factor (Å ²)	28.8	Xtriage
Anisotropy	0.013	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 38.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	2664	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 7.85% 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 [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	0.54	0/1532	0.99	10/2061 (0.5%)
2	B	0.52	0/1041	0.91	6/1399 (0.4%)
All	All	0.53	0/2573	0.96	16/3460 (0.5%)

There are no bond length outliers.

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	102	GLY	CA-C-N	-7.54	112.03	119.87
1	A	102	GLY	C-N-CA	-7.54	112.03	119.87
1	A	13	ILE	CA-C-N	7.36	125.03	119.66
1	A	13	ILE	C-N-CA	7.36	125.03	119.66
2	B	119	ARG	CA-C-N	7.17	127.79	119.47
2	B	119	ARG	C-N-CA	7.17	127.79	119.47
1	A	101	ILE	N-CA-C	6.44	122.73	109.34
2	B	55	LYS	CA-C-N	5.58	126.81	119.84
2	B	55	LYS	C-N-CA	5.58	126.81	119.84
1	A	14	PRO	CA-C-N	5.42	125.50	119.32
1	A	14	PRO	C-N-CA	5.42	125.50	119.32
1	A	182	LYS	N-CA-C	-5.22	106.91	113.28
1	A	12	ARG	CA-C-N	-5.15	118.88	122.59
1	A	12	ARG	C-N-CA	-5.15	118.88	122.59
2	B	28	GLY	CA-C-N	5.08	130.84	121.70
2	B	28	GLY	C-N-CA	5.08	130.84	121.70

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	1506	0	1546	43	0
2	B	1021	0	1024	19	0
3	A	71	0	0	7	0
3	B	66	0	0	4	1
All	All	2664	0	2570	58	1

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 11.

All (58) 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:13:ILE:HD11	1:A:17:MET:HB2	1.48	0.95
1:A:183:ALA:O	3:A:257:HOH:O	1.92	0.86
1:A:1:MET:HE3	2:B:11:TYR:HE2	1.51	0.76
1:A:175:TRP:O	1:A:179:GLU:HG2	1.88	0.73
2:B:42:ARG:NH2	3:B:264:HOH:O	2.23	0.71
2:B:117:GLU:O	2:B:119:ARG:N	2.24	0.70
1:A:13:ILE:HD13	1:A:25:ALA:HB1	1.74	0.69
1:A:174:GLU:OE1	3:A:223:HOH:O	2.10	0.68
1:A:99:ILE:HD13	1:A:142:VAL:HG21	1.76	0.67
1:A:13:ILE:HD12	1:A:14:PRO:HD2	1.78	0.65
2:B:53:LYS:N	3:B:261:HOH:O	2.30	0.64
1:A:1:MET:HE3	2:B:11:TYR:CE2	2.33	0.64
1:A:101:ILE:N	1:A:102:GLY:HA2	2.14	0.63
1:A:1:MET:HB3	1:A:78:GLU:O	2.00	0.61
2:B:18:LYS:NZ	3:B:242:HOH:O	2.34	0.61
1:A:88:GLU:OE2	3:A:217:HOH:O	2.15	0.61
1:A:158:GLU:OE2	3:A:246:HOH:O	2.16	0.60
1:A:181:LYS:HA	1:A:184:LYS:HB2	1.85	0.57
1:A:1:MET:N	3:A:210:HOH:O	2.37	0.56
1:A:182:LYS:NZ	1:A:185:GLU:OE2	2.35	0.56
1:A:37:ILE:HD13	1:A:154:ARG:HH11	1.71	0.55
2:B:23:ARG:NH1	3:B:241:HOH:O	2.16	0.55
1:A:1:MET:HG2	1:A:78:GLU:HG2	1.90	0.54
2:B:120:PRO:C	2:B:122:GLU:H	2.17	0.52
1:A:27:LYS:HE2	1:A:31:ARG:NH2	2.24	0.52
1:A:167:GLN:HB2	1:A:170:LEU:HD12	1.92	0.52
1:A:91:GLU:CD	1:A:93:MET:HE1	2.37	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:93:ARG:HA	2:B:102:MET:HE1	1.93	0.49
1:A:115:ASP:HA	1:A:166:ARG:HH11	1.77	0.49
1:A:116:ASP:OD1	1:A:117:TYR:N	2.41	0.49
1:A:103:PRO:HB3	2:B:44:SER:HB2	1.94	0.49
1:A:182:LYS:HA	1:A:185:GLU:HG3	1.95	0.48
2:B:18:LYS:HD2	2:B:49:GLU:HA	1.95	0.48
1:A:13:ILE:CD1	1:A:17:MET:HB2	2.32	0.47
1:A:38:TYR:HB2	1:A:156:ILE:HD13	1.97	0.46
1:A:16:ARG:NH2	3:A:214:HOH:O	2.49	0.45
2:B:100:GLU:H	2:B:100:GLU:HG3	1.42	0.45
2:B:33:PRO:O	2:B:35:GLU:N	2.48	0.45
1:A:107:LEU:HD23	1:A:162:ASN:ND2	2.33	0.44
1:A:147:ILE:HD12	1:A:147:ILE:HA	1.79	0.44
1:A:1:MET:HB2	1:A:83:GLU:OE2	2.17	0.43
1:A:92:MET:HE2	1:A:126:GLN:HA	1.98	0.43
2:B:45:LEU:O	2:B:49:GLU:HG2	2.18	0.43
2:B:107:GLU:H	2:B:107:GLU:HG2	1.68	0.43
1:A:93:MET:HB3	1:A:93:MET:HE3	1.62	0.43
1:A:142:VAL:HG12	1:A:172:LYS:HA	2.01	0.42
1:A:155:VAL:HA	3:A:204:HOH:O	2.18	0.42
1:A:93:MET:HG2	1:A:96:GLY:O	2.20	0.42
2:B:115:ILE:O	2:B:117:GLU:O	2.38	0.42
1:A:44:VAL:HG22	1:A:156:ILE:HD12	2.01	0.42
2:B:12:ILE:HG23	2:B:16:GLU:HB2	2.03	0.41
2:B:104:THR:OG1	2:B:107:GLU:HG2	2.21	0.41
1:A:172:LYS:HB3	1:A:175:TRP:CD2	2.56	0.41
1:A:179:GLU:O	1:A:183:ALA:HB3	2.20	0.41
1:A:1:MET:HE2	1:A:78:GLU:OE1	2.20	0.41
1:A:21:ASP:HB3	1:A:24:GLU:HG3	2.04	0.40
1:A:102:GLY:O	2:B:43:VAL:HG12	2.20	0.40
1:A:37:ILE:HG23	1:A:154:ARG:HB3	2.03	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:B:210:HOH:O	3:B:240:HOH:O[3_544]	2.19	0.01

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	184/190 (97%)	176 (96%)	6 (3%)	2 (1%)	11	12
2	B	120/122 (98%)	110 (92%)	6 (5%)	4 (3%)	3	1
All	All	304/312 (97%)	286 (94%)	12 (4%)	6 (2%)	6	4

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	28	GLY
1	A	180	LYS
2	B	31	GLU
2	B	34	GLU
1	A	181	LYS
2	B	33	PRO

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	164/167 (98%)	149 (91%)	15 (9%)	9	11
2	B	107/107 (100%)	94 (88%)	13 (12%)	5	5
All	All	271/274 (99%)	243 (90%)	28 (10%)	7	8

All (28) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	4	LEU
1	A	11	VAL
1	A	13	ILE
1	A	22	PRO
1	A	80	ARG
1	A	93	MET
1	A	123	LYS
1	A	133	ASN
1	A	147	ILE
1	A	155	VAL
1	A	156	ILE
1	A	166	ARG
1	A	177	GLU
1	A	182	LYS
2	B	5	LYS
2	B	7	LEU
2	B	23	ARG
2	B	32	ASN
2	B	40	GLU
2	B	50	ARG
2	B	55	LYS
2	B	71	ASP
2	B	85	LEU
2	B	90	LEU
2	B	100	GLU
2	B	107	GLU
2	B	121	LEU

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	126	GLN
1	A	162	ASN

5.3.3 RNA ⓘ

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 [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	186/190 (97%)	-0.12	3 (1%) 70 72	13, 29, 61, 114	0
2	B	122/122 (100%)	-0.14	6 (4%) 35 37	16, 30, 63, 92	0
All	All	308/312 (98%)	-0.13	9 (2%) 53 56	13, 29, 63, 114	0

All (9) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	33	PRO	3.4
2	B	32	ASN	3.2
1	A	181	LYS	3.1
2	B	121	LEU	2.9
2	B	30	ALA	2.9
1	A	183	ALA	2.7
2	B	7	LEU	2.2
2	B	29	LEU	2.1
1	A	18	PHE	2.1

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](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.