



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 20, 2026 – 10:52 AM UTC

PDB ID : 3N97 / pdb_00003n97
Title : RNA polymerase alpha C-terminal domain (E. coli) and sigma region 4 (T. aq. mutant) bound to (UP,-35 element) DNA
Authors : Lara-Gonzalez, S.; Birktoft, J.J.; Lawson, C.L.
Deposited on : 2010-05-28
Resolution : 3.25 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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

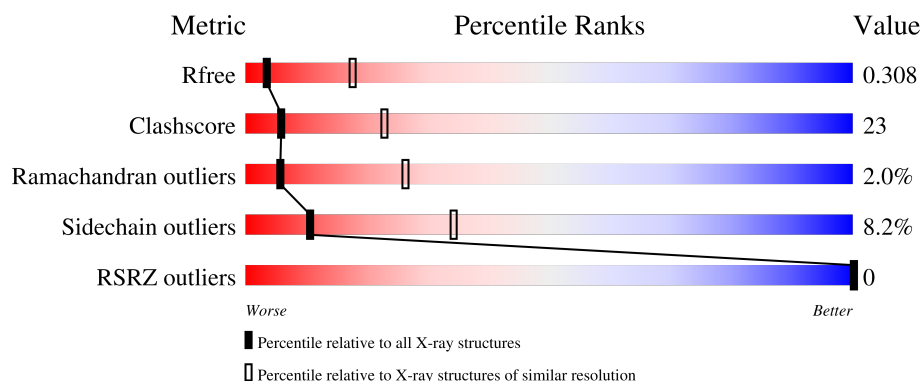
1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.25 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.



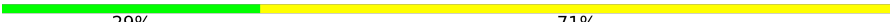
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	1605 (3.30-3.22)
Clashscore	190562	1660 (3.30-3.22)
Ramachandran outliers	187476	1630 (3.30-3.22)
Sidechain outliers	187428	1629 (3.30-3.22)
RSRZ outliers	180081	1605 (3.30-3.22)

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	72	32% 36% • • 26%
1	D	72	24% 39% 6% • 31%
2	B	84	65% 19% 5% 11%
2	C	84	56% 26% 6% 12%
3	M	22	23% 73% 5%

Continued on next page...

Continued from previous page...

Mol	Chain	Length	Quality of chain
4	N	21	 29% 71%

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 2886 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 RNA polymerase sigma factor.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	53	Total	C	N	O	S	0	0	0
			433	268	87	76	2			
1	D	50	Total	C	N	O	S	0	0	0
			410	254	82	72	2			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	386	MET	LEU	engineered mutation	UNP Q9EZJ8
A	?	-	LYS	SEE REMARK 999	UNP Q9EZJ8
A	424	ARG	TYR	SEE REMARK 999	UNP Q9EZJ8
A	426	PRO	GLU	SEE REMARK 999	UNP Q9EZJ8
A	429	SER	THR	engineered mutation	UNP Q9EZJ8
A	430	GLU	ARG	engineered mutation	UNP Q9EZJ8
D	386	MET	LEU	engineered mutation	UNP Q9EZJ8
D	?	-	LYS	SEE REMARK 999	UNP Q9EZJ8
D	424	ARG	TYR	SEE REMARK 999	UNP Q9EZJ8
D	426	PRO	GLU	SEE REMARK 999	UNP Q9EZJ8
D	429	SER	THR	engineered mutation	UNP Q9EZJ8
D	430	GLU	ARG	engineered mutation	UNP Q9EZJ8

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	75	Total	C	N	O	S	0	0	0
			584	370	102	110	2			
2	C	74	Total	C	N	O	S	0	0	0
			579	367	101	109	2			

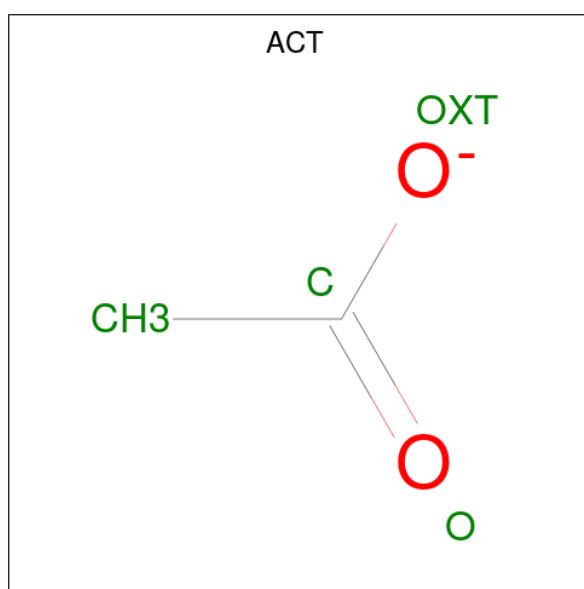
- Molecule 3 is a DNA chain called DNA (5'-D(*TP*GP*GP*AP*AP*AP*AP*AP*AP*GP*TP*AP*CP*TP*TP*GP*AP*CP*AP*TP*GP*G)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	M	22	Total	C	N	O	P	0	0	0
			456	218	91	126	21			

- Molecule 4 is a DNA chain called DNA (5'-D(*CP*CP*AP*TP*GP*TP*CP*AP*AP*GP*TP*AP*CP*TP*TP*TP*TP*TP*TP*TP*CP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	N	21	Total	C	N	O	P	0	0	0
			419	204	66	129	20			

- Molecule 5 is ACETATE ION (CCD ID: ACT) (formula: C₂H₃O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	C	1	Total	C	O	0	0
			4	2	2		

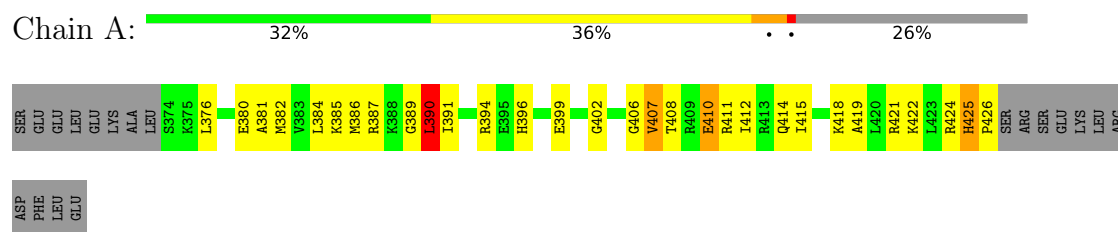
- Molecule 6 is water.

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

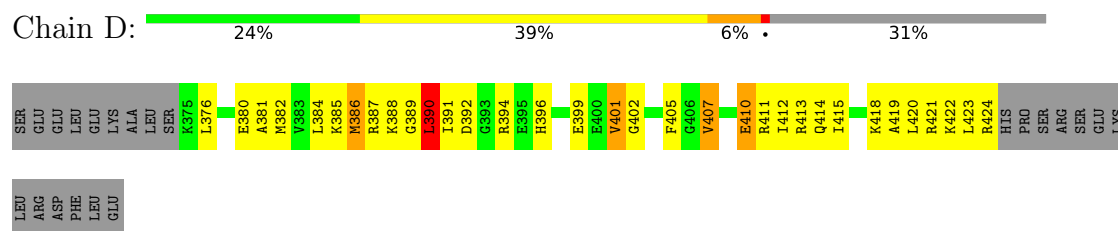
3 Residue-property plots

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.

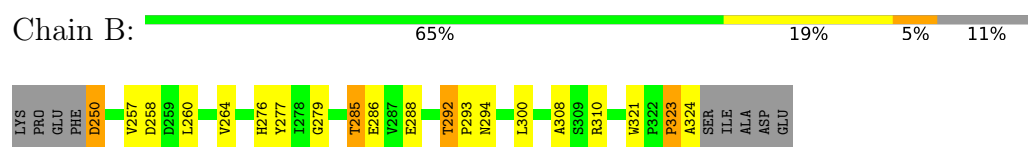
- Molecule 1: RNA polymerase sigma factor



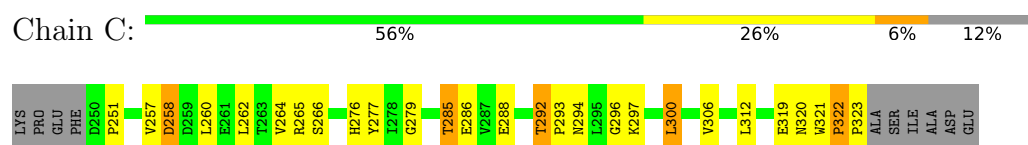
- Molecule 1: RNA polymerase sigma factor



- Molecule 2: DNA-directed RNA polymerase subunit alpha

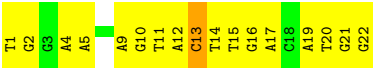


- Molecule 2: DNA-directed RNA polymerase subunit alpha

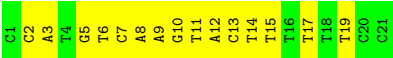


- Molecule 3: DNA (5'-D(*TP*GP*GP*AP*AP*AP*AP*AP*AP*GP*TP*AP*CP*TP*TP*GP*AP*CP*AP*TP*GP*G)-3')





● Molecule 4: DNA (5'-D(*CP*CP*AP*TP*GP*TP*CP*AP*AP*GP*TP*AP*CP*TP*TP*TP*TP*TP*TP*TP*CP*C)-3')



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	80.71Å 86.41Å 147.11Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	25.43 – 3.25 25.43 – 3.25	Depositor EDS
% Data completeness (in resolution range)	88.7 (25.43-3.25) 88.4 (25.43-3.25)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	0.08	Depositor
$\langle I/\sigma(I) \rangle$	-	Xtrriage
Refinement program	PHENIX	Depositor
R, R_{free}	0.254 , 0.295 0.255 , 0.308	Depositor DCC
R_{free} test set	482 reflections (6.46%)	wwPDB-VP
Wilson B-factor (Å ²)	(Not available)	Xtrriage
Anisotropy	(Not available)	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.28 , 69.6	EDS
L-test for twinning ¹	$\langle L \rangle =$ (Not available), $\langle L^2 \rangle =$ (Not available)	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	2886	wwPDB-VP
Average B, all atoms (Å ²)	139.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *(Not available)*

¹Theoretical 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](#)

Bond lengths and bond angles in the following residue types are not validated in this section: ACT

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	0.42	0/437	0.79	0/580
1	D	0.41	0/412	0.75	0/545
2	B	0.40	0/592	0.90	4/803 (0.5%)
2	C	0.35	0/587	0.80	2/796 (0.3%)
3	M	0.27	0/514	1.01	1/793 (0.1%)
4	N	0.28	0/466	0.94	0/716
All	All	0.36	0/3008	0.88	7/4233 (0.2%)

There are no bond length outliers.

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	292	THR	CA-C-N	5.71	125.64	119.76
2	C	292	THR	C-N-CA	5.71	125.64	119.76
2	B	292	THR	CA-C-N	5.62	125.57	119.78
2	B	292	THR	C-N-CA	5.62	125.57	119.78
2	B	250	ASP	CA-C-N	5.54	125.24	119.64

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	433	0	451	29	0
1	D	410	0	432	26	0
2	B	584	0	614	14	0
2	C	579	0	609	22	0
3	M	456	0	249	31	0
4	N	419	0	242	17	0
5	C	4	0	3	1	0
6	C	1	0	0	0	0
All	All	2886	0	2600	126	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 23.

The worst 5 of 126 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)
4:N:8:DA:H1'	4:N:9:DA:H5''	1.65	0.78
1:D:407:VAL:HG11	1:D:411:ARG:HG2	1.69	0.74
3:M:14:DT:H2''	3:M:15:DT:H5'	1.73	0.71
3:M:16:DG:H2''	3:M:17:DA:OP2	1.91	0.71
2:C:322:PRO:HD2	2:C:323:PRO:HD2	1.73	0.69

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	51/72 (71%)	46 (90%)	4 (8%)	1 (2%)	6	26
1	D	48/72 (67%)	41 (85%)	6 (12%)	1 (2%)	5	25
2	B	73/84 (87%)	66 (90%)	6 (8%)	1 (1%)	9	33
2	C	72/84 (86%)	63 (88%)	7 (10%)	2 (3%)	4	20

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
All	All	244/312 (78%)	216 (88%)	23 (9%)	5 (2%)	6	26

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	C	322	PRO
1	D	390	LEU
1	A	390	LEU
2	C	251	PRO
2	B	323	PRO

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	45/64 (70%)	40 (89%)	5 (11%)	6	23
1	D	42/64 (66%)	36 (86%)	6 (14%)	3	14
2	B	66/74 (89%)	63 (96%)	3 (4%)	24	52
2	C	66/74 (89%)	62 (94%)	4 (6%)	17	44
All	All	219/276 (79%)	201 (92%)	18 (8%)	10	34

5 of 18 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	C	258	ASP
2	C	300	LEU
2	C	297	LYS
1	D	401	VAL
2	B	285	THR

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	414	GLN
2	B	320	ASN
2	C	320	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

1 ligand is 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	$\# Z > 2$
5	ACT	C	1	-	3,3,3	0.83	0	3,3,3	1.31	0

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	C	1	ACT	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	53/72 (73%)	-0.33	0 100 100	101, 127, 165, 196	0
1	D	50/72 (69%)	-0.25	0 100 100	109, 131, 159, 161	0
2	B	75/84 (89%)	-0.39	0 100 100	87, 121, 174, 212	0
2	C	74/84 (88%)	-0.23	0 100 100	99, 144, 213, 245	0
3	M	22/22 (100%)	-0.52	0 100 100	101, 137, 208, 228	0
4	N	21/21 (100%)	-0.43	0 100 100	98, 135, 181, 217	0
All	All	295/355 (83%)	-0.33	0 100 100	87, 131, 205, 245	0

There are no RSRZ outliers to report.

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(Å ²)	Q<0.9
5	ACT	C	1	4/4	0.95	0.25	143,144,144,146	0

6.5 Other polymers [i](#)

There are no such residues in this entry.