



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 7, 2026 – 12:57 AM UTC

PDB ID : 1K82 / pdb_00001k82
Title : Crystal structure of E.coli formamidopyrimidine-DNA glycosylase (Fpg) covalently trapped with DNA
Authors : Gilboa, R.; Zharkov, D.O.; Golan, G.; Fernandes, A.S.; Gerchman, S.E.; Matz, E.; Kycia, J.H.; Grollman, A.P.; Shoham, G.
Deposited on : 2001-10-22
Resolution : 2.10 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)	:	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

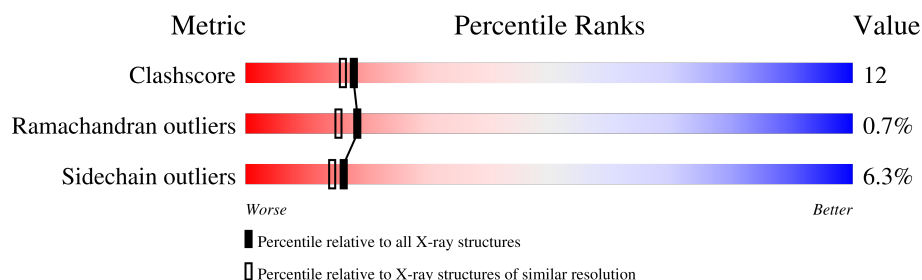
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.10 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	7164 (2.10-2.10)
Ramachandran outliers	187476	7099 (2.10-2.10)
Sidechain outliers	187428	7100 (2.10-2.10)

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	E	13	62% 38%
1	F	13	8% 69% 23%
1	G	13	15% 62% 23%
1	H	13	31% 46% 23%
2	I	13	31% 38% 31%
2	J	13	31% 38% 31%
2	K	13	31% 54% 15%
2	L	13	23% 54% 23%

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Mol	Chain	Length	Quality of chain
3	A	268	71%23%
3	B	268	69%25%
3	C	268	71%21%5%
3	D	268	75%22%

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 10716 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 DNA chain called 5'-D(*GP*GP*CP*TP*TP*CP*CP*TP*CP*CP*TP*GP*G)-3'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	E	13	Total	C	N	O	P	0	0	0
			260	125	43	80	12			
1	F	13	Total	C	N	O	P	0	0	0
			260	125	43	80	12			
1	G	13	Total	C	N	O	P	0	0	0
			260	125	43	80	12			
1	H	13	Total	C	N	O	P	0	0	0
			260	125	43	80	12			

- Molecule 2 is a DNA chain called 5'-D(*CP*CP*AP*GP*GP*AP*(PED)P*GP*AP*AP*GP*CP*C)-3'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	I	13	Total	C	N	O	P	0	0	0
			256	121	52	71	12			
2	J	13	Total	C	N	O	P	0	0	0
			256	121	52	71	12			
2	K	13	Total	C	N	O	P	0	0	0
			256	121	52	71	12			
2	L	13	Total	C	N	O	P	0	0	0
			256	121	52	71	12			

- Molecule 3 is a protein called formamidopyrimidine-DNA glycosylase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	A	260	Total	C	N	O	S	0	0	0
			2038	1297	370	362	9			
3	B	260	Total	C	N	O	S	0	0	0
			2030	1293	367	361	9			
3	C	260	Total	C	N	O	S	0	0	0
			2042	1299	368	366	9			

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	260	Total	C	N	O	S	0	0	0
			2039	1298	370	362	9			

- Molecule 4 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Zn	0	0
			1	1		
4	B	1	Total	Zn	0	0
			1	1		
4	C	1	Total	Zn	0	0
			1	1		
4	D	1	Total	Zn	0	0
			1	1		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	E	15	Total	O	0	0
			15	15		
5	I	23	Total	O	0	0
			23	23		
5	F	16	Total	O	0	0
			16	16		
5	J	24	Total	O	0	0
			24	24		
5	G	18	Total	O	0	0
			18	18		
5	K	20	Total	O	0	0
			20	20		
5	H	18	Total	O	0	0
			18	18		
5	L	21	Total	O	0	0
			21	21		
5	A	93	Total	O	0	0
			93	93		
5	B	82	Total	O	0	0
			82	82		
5	C	77	Total	O	0	0
			77	77		
5	D	92	Total	O	0	0
			92	92		

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. 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.

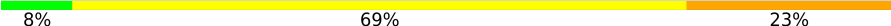
Note EDS was not executed.

- Molecule 1: 5'-D(*GP*GP*CP*TP*TP*CP*CP*TP*CP*CP*TP*GP*G)-3'

Chain E: 

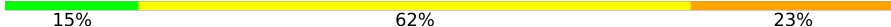


- Molecule 1: 5'-D(*GP*GP*CP*TP*TP*CP*CP*TP*CP*CP*TP*GP*G)-3'

Chain F: 



- Molecule 1: 5'-D(*GP*GP*CP*TP*TP*CP*CP*TP*CP*CP*TP*GP*G)-3'

Chain G: 

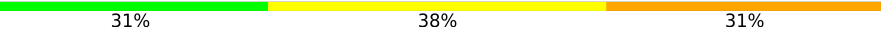


- Molecule 1: 5'-D(*GP*GP*CP*TP*TP*CP*CP*TP*CP*CP*TP*GP*G)-3'

Chain H: 

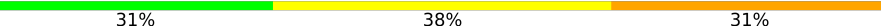


- Molecule 2: 5'-D(*CP*CP*AP*GP*GP*AP*(PED)P*GP*AP*AP*GP*CP*C)-3'

Chain I: 

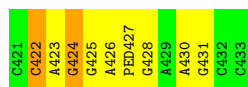


- Molecule 2: 5'-D(*CP*CP*AP*GP*GP*AP*(PED)P*GP*AP*AP*GP*CP*C)-3'

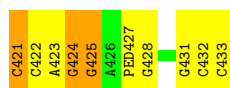
Chain J: 



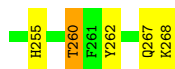
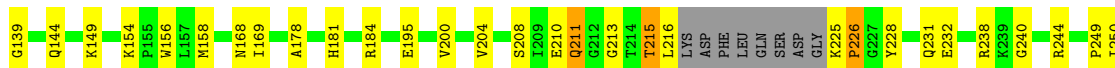
- Molecule 2: 5'-D(*CP*CP*AP*GP*GP*AP*(PED)P*GP*AP*AP*GP*CP*C)-3'



- Molecule 2: 5'-D(*CP*CP*AP*GP*GP*AP*(PED)P*GP*AP*AP*GP*CP*C)-3'



- Molecule 3: formamidopyrimidine-DNA glycosylase

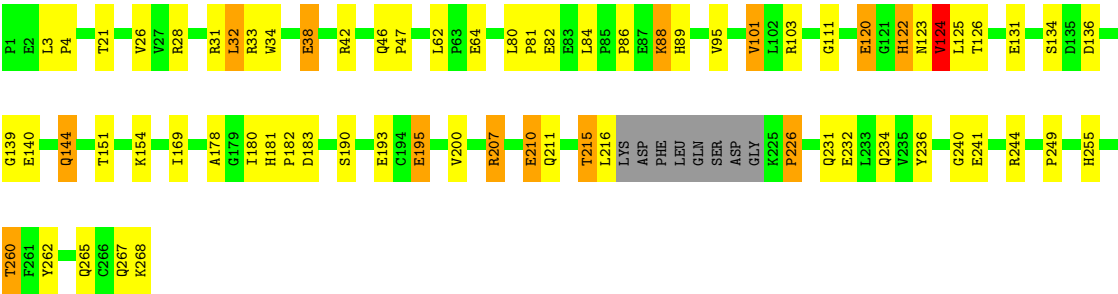


- Molecule 3: formamidopyrimidine-DNA glycosylase

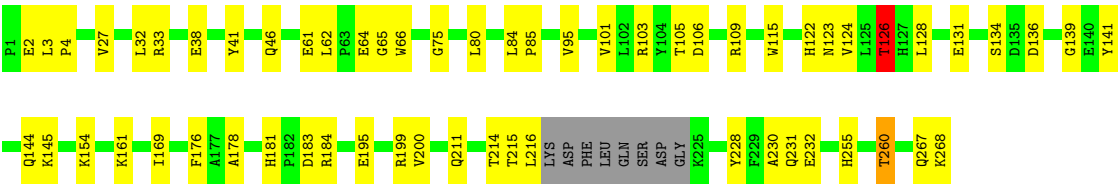


- Molecule 3: formamidopyrimidine-DNA glycosylase





● Molecule 3: formamidopyrimidine-DNA glycosylase



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	80.70Å 96.03Å 96.23Å 90.00° 96.80° 90.00°	Depositor
Resolution (Å)	34.00 – 2.10	Depositor
% Data completeness (in resolution range)	(Not available) (34.00-2.10)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	0.07	Depositor
Refinement program	CNS 1.0	Depositor
R, R_{free}	0.214 , 0.265	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	10716	wwPDB-VP
Average B, all atoms (Å ²)	37.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

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

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	E	1.21	1/289 (0.3%)	2.43	30/444 (6.8%)
1	F	1.20	1/289 (0.3%)	2.40	22/444 (5.0%)
1	G	1.19	0/289	2.42	18/444 (4.1%)
1	H	1.19	0/289	2.45	23/444 (5.2%)
2	I	0.84	0/275	2.26	20/420 (4.8%)
2	J	0.83	0/275	2.38	21/420 (5.0%)
2	K	0.82	0/275	2.33	19/420 (4.5%)
2	L	0.83	0/275	2.32	18/420 (4.3%)
3	A	0.38	0/2085	1.04	0/2826
3	B	0.39	0/2076	1.05	2/2815 (0.1%)
3	C	0.38	0/2088	1.07	1/2830 (0.0%)
3	D	0.39	0/2086	1.08	4/2828 (0.1%)
All	All	0.59	2/10591 (0.0%)	1.48	178/14755 (1.2%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	E	404	DT	C5-C7	5.25	1.60	1.50
1	F	411	DT	C5-C7	5.01	1.60	1.50

The worst 5 of 178 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	31	ARG	CD-NE-CZ	8.36	136.11	124.40
1	F	412	DG	C8-N9-C1'	7.50	138.26	127.00
1	E	404	DT	N1-C1'-C2'	7.43	124.65	113.50
3	D	126	THR	CA-C-O	-7.42	109.91	120.51
1	E	413	DG	N7-C8-N9	7.18	124.27	113.50

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	E	260	0	149	9	0
1	F	260	0	149	5	0
1	G	260	0	149	2	0
1	H	260	0	149	9	0
2	I	256	0	142	6	0
2	J	256	0	142	5	0
2	K	256	0	142	4	0
2	L	256	0	142	7	0
3	A	2038	0	2058	44	0
3	B	2030	0	2048	56	0
3	C	2042	0	2062	56	0
3	D	2039	0	2059	42	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
4	C	1	0	0	0	0
4	D	1	0	0	0	0
5	A	93	0	0	1	0
5	B	82	0	0	2	0
5	C	77	0	0	1	0
5	D	92	0	0	1	0
5	E	15	0	0	0	0
5	F	16	0	0	0	0
5	G	18	0	0	1	0
5	H	18	0	0	0	0
5	I	23	0	0	0	0
5	J	24	0	0	0	0
5	K	20	0	0	1	0
5	L	21	0	0	1	0
All	All	10716	0	9391	239	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.

The worst 5 of 239 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)
3:C:122:HIS:ND1	3:C:123:ASN:O	1.76	1.16
3:D:211:GLN:OE1	3:D:232:GLU:OE2	1.76	1.03
3:A:80:LEU:HD13	3:A:84:LEU:HD23	1.45	0.99
3:C:122:HIS:CE1	3:C:123:ASN:O	2.17	0.98
3:D:122:HIS:C	3:D:126:THR:OG1	2.07	0.96

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	
3	A	256/268 (96%)	243 (95%)	10 (4%)	3 (1%)	10	7
3	B	256/268 (96%)	244 (95%)	11 (4%)	1 (0%)	30	28
3	C	256/268 (96%)	249 (97%)	5 (2%)	2 (1%)	16	12
3	D	256/268 (96%)	240 (94%)	15 (6%)	1 (0%)	30	28
All	All	1024/1072 (96%)	976 (95%)	41 (4%)	7 (1%)	18	15

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	A	226	PRO
3	B	123	ASN
3	C	124	VAL
3	A	82	GLU
3	A	123	ASN

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	
3	A	218/230 (95%)	203 (93%)	15 (7%)	14	12
3	B	216/230 (94%)	201 (93%)	15 (7%)	14	12
3	C	219/230 (95%)	202 (92%)	17 (8%)	11	9
3	D	218/230 (95%)	210 (96%)	8 (4%)	30	33
All	All	871/920 (95%)	816 (94%)	55 (6%)	16	14

5 of 55 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	B	260	THR
3	C	88	LYS
3	D	268	LYS
3	D	38	GLU
3	B	268	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 19 such sidechains are listed below:

Mol	Chain	Res	Type
3	C	181	HIS
3	D	211	GLN
3	D	257	GLN
3	D	122	HIS
3	B	234	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry

Of 4 ligands modelled in this entry, 4 are monoatomic - leaving 0 for Mogul analysis.

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.

No monomer is involved in short contacts.

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

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.