



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 06:39 PM UTC

PDB ID : 1YFH / pdb_00001yfh
Title : wt Human O6-Alkylguanine-DNA Alkyltransferase Bound To DNA Contain-
ing an Alkylated Cytosine
Authors : Duguid, E.M.; Rice, P.A.; He, C.
Deposited on : 2004-12-31
Resolution : 3.01 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

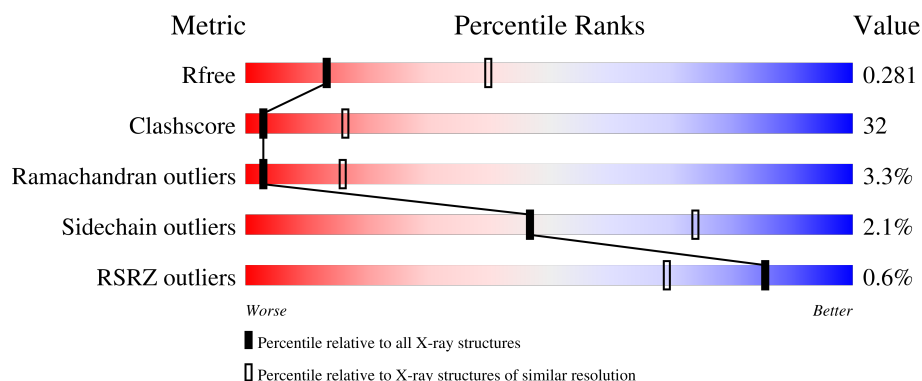
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.01 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.



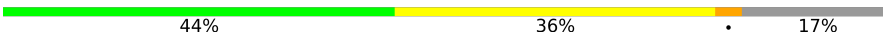
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	3131 (3.04-3.00)
Clashscore	190562	3444 (3.04-3.00)
Ramachandran outliers	187476	3319 (3.04-3.00)
Sidechain outliers	187428	3322 (3.04-3.00)
RSRZ outliers	180081	3130 (3.04-3.00)

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	D	16	
1	F	16	
2	E	16	
2	G	16	
3	A	179	

Continued on next page...

Continued from previous page...

Mol	Chain	Length	Quality of chain
3	B	179	 42% 42% 5% 10%
3	C	179	 44% 36% • 17%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 4946 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*TP*GP*GP*AP*TP*GP*(XCY)P*GP*TP*GP*TP*AP*GP*GP*T)-3'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	D	16	Total	C	N	O	P	0	0	0
			343	167	64	97	15			
1	F	16	Total	C	N	O	P	0	0	0
			343	167	64	97	15			

- Molecule 2 is a DNA chain called 5'-D(*CP*CP*TP*AP*CP*AP*CP*AP*CP*AP*TP*CP*CP*AP*CP*A)-3'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	E	16	Total	C	N	O	P	0	0	0
			315	152	58	90	15			
2	G	16	Total	C	N	O	P	0	0	0
			315	152	58	90	15			

- Molecule 3 is a protein called Methylated-DNA--protein-cysteine methyltransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	A	165	Total	C	N	O	S	0	0	0
			1252	805	221	218	8			
3	B	161	Total	C	N	O	S	0	0	0
			1223	786	216	213	8			
3	C	149	Total	C	N	O	S	0	0	0
			1146	737	203	198	8			

- 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		

Continued on next page...

Continued from previous page...

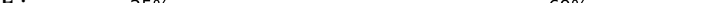
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	C	1	Total 1	Zn 1	0	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	F	2	Total 2	O 2	0	0
5	A	1	Total 1	O 1	0	0
5	B	1	Total 1	O 1	0	0
5	C	2	Total 2	O 2	0	0

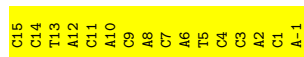
• Molecule 1: 5'-D(*GP*TP*GP*GP*AP*TP*GP*(XCY)P*GP*TP*GP*TP*AP*GP*GP*T)-3'

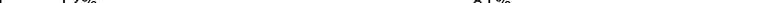


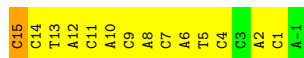
Chain F:  6% 25% 69% 6%

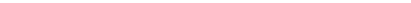


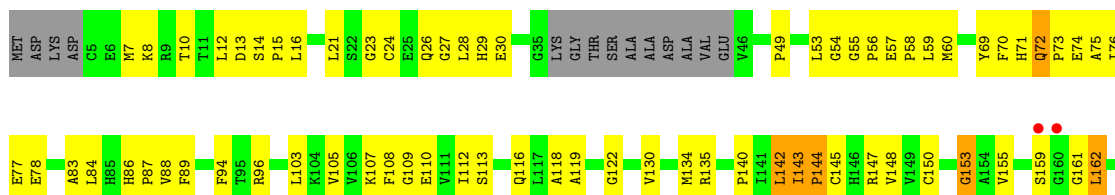
Chain E: 100%



Chain G:  12% 81% 6%



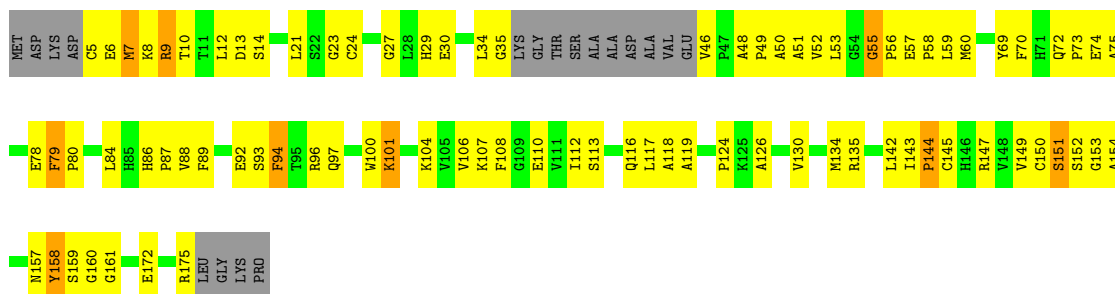
Chain A:  48% 40% 8%





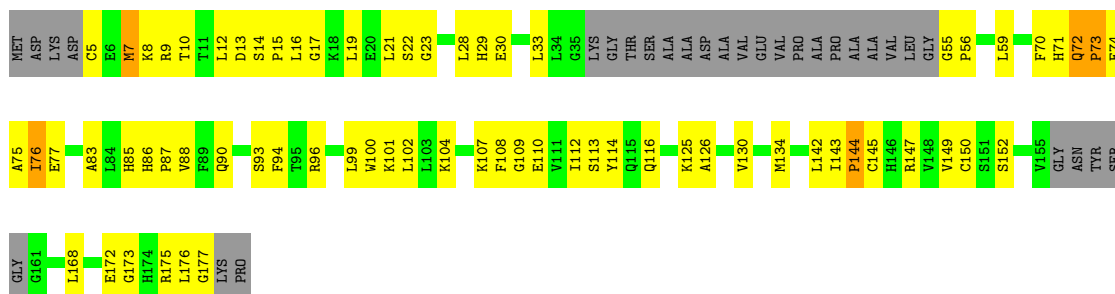
• Molecule 3: Methylated-DNA--protein-cysteine methyltransferase

Chain B: 42% 42% 5% 10%



• Molecule 3: Methylated-DNA--protein-cysteine methyltransferase

Chain C: 44% 36% 17%



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	58.15Å 102.71Å 87.94Å 90.00° 106.77° 90.00°	Depositor
Resolution (Å)	29.17 – 3.01 29.17 – 3.01	Depositor EDS
% Data completeness (in resolution range)	88.0 (29.17-3.01) 88.1 (29.17-3.01)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.98 (at 3.00Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.246 , 0.286 0.247 , 0.281	Depositor DCC
R_{free} test set	835 reflections (4.30%)	wwPDB-VP
Wilson B-factor (Å ²)	73.5	Xtriage
Anisotropy	0.278	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 49.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.031 for h,-k,-h-l	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	4946	wwPDB-VP
Average B, all atoms (Å ²)	76.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.07% 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

5.1 Standard geometry

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

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	D	0.38	0/353	0.77	0/544
1	F	0.41	0/353	0.81	0/544
2	E	0.42	0/352	0.79	0/538
2	G	0.43	0/352	0.78	0/538
3	A	0.59	0/1285	1.06	8/1744 (0.5%)
3	B	0.57	0/1255	1.06	10/1705 (0.6%)
3	C	0.58	0/1174	1.09	5/1590 (0.3%)
All	All	0.54	0/5124	1.00	23/7203 (0.3%)

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
2	G	0	1

There are no bond length outliers.

The worst 5 of 23 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	105	VAL	N-CA-C	9.25	119.16	110.74
3	C	142	LEU	N-CA-C	-7.52	103.02	111.14
3	B	142	LEU	N-CA-C	-7.52	102.69	111.03
3	A	142	LEU	N-CA-C	-7.27	103.29	111.14
3	C	7	MET	N-CA-C	7.13	120.30	110.24

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	G	15	DC	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	D	343	0	192	27	0
1	F	343	0	192	27	0
2	E	315	0	180	28	0
2	G	315	0	180	22	0
3	A	1252	0	1268	76	0
3	B	1223	0	1234	84	0
3	C	1146	0	1159	60	0
4	A	1	0	0	0	0
4	B	1	0	0	1	0
4	C	1	0	0	0	0
5	A	1	0	0	0	0
5	B	1	0	0	0	0
5	C	2	0	0	1	0
5	F	2	0	0	1	0
All	All	4946	0	4405	301	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 32.

The worst 5 of 301 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)
2:E:14:DC:H2''	2:E:13:DT:H71	1.41	1.03
3:B:101:LYS:HE3	3:B:101:LYS:HA	1.44	0.98
1:D:1:DG:H2''	1:D:2:DT:H5'	1.45	0.96
3:B:7:MET:HE1	3:B:24:CYS:HB3	1.46	0.96
3:B:7:MET:CE	3:B:24:CYS:HB3	1.97	0.94

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	161/179 (90%)	138 (86%)	18 (11%)	5 (3%)	3	17
3	B	157/179 (88%)	130 (83%)	21 (13%)	6 (4%)	2	13
3	C	143/179 (80%)	121 (85%)	18 (13%)	4 (3%)	4	19
All	All	461/537 (86%)	389 (84%)	57 (12%)	15 (3%)	3	16

5 of 15 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	A	72	GLN
3	C	72	GLN
3	A	55	GLY
3	B	153	GLY
3	B	160	GLY

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	131/141 (93%)	128 (98%)	3 (2%)	44	72
3	B	128/141 (91%)	124 (97%)	4 (3%)	35	67
3	C	121/141 (86%)	120 (99%)	1 (1%)	73	85
All	All	380/423 (90%)	372 (98%)	8 (2%)	47	74

5 of 8 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	C	76	ILE
3	B	151	SER
3	B	79	PHE
3	B	9	ARG
3	B	101	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 16 such sidechains are listed below:

Mol	Chain	Res	Type
3	C	90	GLN
3	C	72	GLN
3	B	97	GLN
3	C	67	ASN
3	B	90	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

2 non-standard protein/DNA/RNA residues are 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	$\# Z > 2$
1	XCY	D	8	1	26,30,31	1.35	5 (19%)	34,41,44	0.41	0
1	XCY	F	8	1	26,30,31	1.28	5 (19%)	34,41,44	0.40	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
1	XCY	D	8	1	-	0/13/28/29	0/3/3/3
1	XCY	F	8	1	-	0/13/28/29	0/3/3/3

The worst 5 of 10 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	8	XCY	CE2-CD2	3.56	1.44	1.38
1	D	8	XCY	CE1-CD1	3.34	1.44	1.38
1	F	8	XCY	CE2-CD2	3.33	1.44	1.38
1	F	8	XCY	CE1-CD1	3.26	1.44	1.38
1	D	8	XCY	CD1-CG	2.50	1.43	1.38

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 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	F	8	XCY	5	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 3 ligands modelled in this entry, 3 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 [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	D	15/16 (93%)	0.62	0 100 100	65, 89, 101, 105	0
1	F	15/16 (93%)	0.30	1 (6%) 24 12	47, 73, 91, 105	0
2	E	16/16 (100%)	0.58	0 100 100	66, 94, 101, 102	0
2	G	16/16 (100%)	0.54	0 100 100	55, 75, 88, 98	0
3	A	165/179 (92%)	0.07	2 (1%) 76 55	59, 74, 82, 88	0
3	B	161/179 (89%)	-0.04	0 100 100	66, 76, 85, 93	0
3	C	149/179 (83%)	0.06	0 100 100	58, 74, 83, 92	0
All	All	537/601 (89%)	0.08	3 (0%) 85 69	47, 75, 89, 105	0

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	A	160	GLY	2.6
3	A	159	SER	2.0
1	F	16	DT	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [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
1	XCY	D	8	28/29	0.91	0.11	73,73,77,77	0
1	XCY	F	8	28/29	0.94	0.11	77,93,93,93	0

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($\text{\AA}^2$)	Q<0.9
4	ZN	A	301	1/1	0.99	0.03	77,77,77,77	0
4	ZN	B	303	1/1	0.99	0.02	77,77,77,77	0
4	ZN	C	302	1/1	0.99	0.02	77,77,77,77	0

6.5 Other polymers [i](#)

There are no such residues in this entry.