



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 11:48 AM UTC

PDB ID : 5C28 / pdb_00005c28
Title : PDE10 complexed with 6-chloro-2-cyclopropyl-5-methyl-pyrimidin-4-amine
Authors : Yan, Y.
Deposited on : 2015-06-15
Resolution : 1.56 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
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

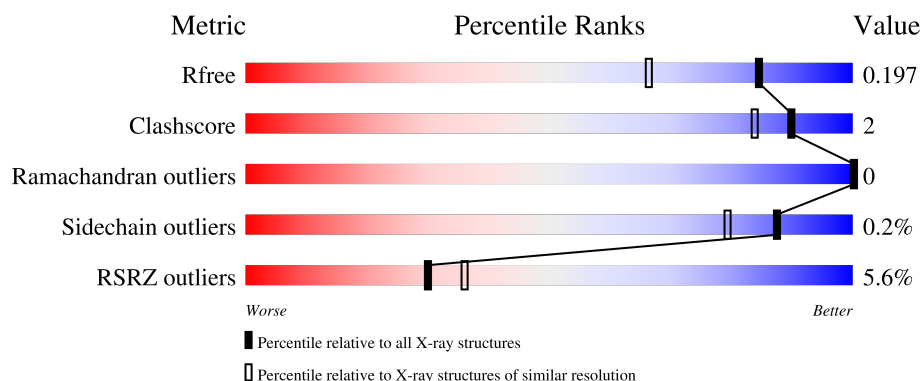
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.56 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	2145 (1.56-1.56)
Clashscore	190562	2189 (1.56-1.56)
Ramachandran outliers	187476	2153 (1.56-1.56)
Sidechain outliers	187428	2150 (1.56-1.56)
RSRZ outliers	180081	2146 (1.56-1.56)

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	362	5% 85% 5% 10%
1	B	362	5% 83% 5% 12%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 5776 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 cAMP and cAMP-inhibited cGMP 3',5'-cyclic phosphodiesterase 10A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	325	Total	C	N	O	S	0	1	0
			2625	1676	446	477	26			
1	B	317	Total	C	N	O	S	0	3	0
			2560	1630	438	467	25			

There are 42 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	418	MET	-	initiating methionine	UNP Q9Y233
A	419	GLY	-	expression tag	UNP Q9Y233
A	420	SER	-	expression tag	UNP Q9Y233
A	421	SER	-	expression tag	UNP Q9Y233
A	422	HIS	-	expression tag	UNP Q9Y233
A	423	HIS	-	expression tag	UNP Q9Y233
A	424	HIS	-	expression tag	UNP Q9Y233
A	425	HIS	-	expression tag	UNP Q9Y233
A	426	HIS	-	expression tag	UNP Q9Y233
A	427	HIS	-	expression tag	UNP Q9Y233
A	428	SER	-	expression tag	UNP Q9Y233
A	429	SER	-	expression tag	UNP Q9Y233
A	430	GLY	-	expression tag	UNP Q9Y233
A	431	LEU	-	expression tag	UNP Q9Y233
A	432	VAL	-	expression tag	UNP Q9Y233
A	433	PRO	-	expression tag	UNP Q9Y233
A	434	ARG	-	expression tag	UNP Q9Y233
A	435	GLY	-	expression tag	UNP Q9Y233
A	436	SER	-	expression tag	UNP Q9Y233
A	437	HIS	-	expression tag	UNP Q9Y233
A	438	MET	-	expression tag	UNP Q9Y233
B	418	MET	-	initiating methionine	UNP Q9Y233
B	419	GLY	-	expression tag	UNP Q9Y233
B	420	SER	-	expression tag	UNP Q9Y233

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Chain	Residue	Modelled	Actual	Comment	Reference
B	421	SER	-	expression tag	UNP Q9Y233
B	422	HIS	-	expression tag	UNP Q9Y233
B	423	HIS	-	expression tag	UNP Q9Y233
B	424	HIS	-	expression tag	UNP Q9Y233
B	425	HIS	-	expression tag	UNP Q9Y233
B	426	HIS	-	expression tag	UNP Q9Y233
B	427	HIS	-	expression tag	UNP Q9Y233
B	428	SER	-	expression tag	UNP Q9Y233
B	429	SER	-	expression tag	UNP Q9Y233
B	430	GLY	-	expression tag	UNP Q9Y233
B	431	LEU	-	expression tag	UNP Q9Y233
B	432	VAL	-	expression tag	UNP Q9Y233
B	433	PRO	-	expression tag	UNP Q9Y233
B	434	ARG	-	expression tag	UNP Q9Y233
B	435	GLY	-	expression tag	UNP Q9Y233
B	436	SER	-	expression tag	UNP Q9Y233
B	437	HIS	-	expression tag	UNP Q9Y233
B	438	MET	-	expression tag	UNP Q9Y233

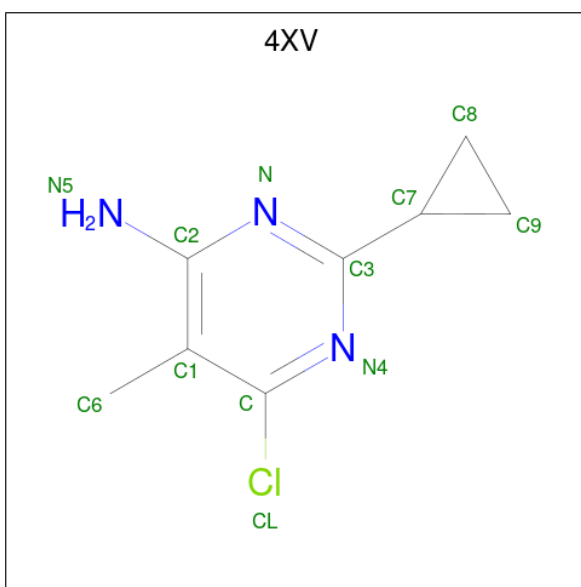
- Molecule 2 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total Zn 1 1	0	0
2	B	1	Total Zn 1 1	0	0

- Molecule 3 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total Mg 1 1	0	0
3	B	1	Total Mg 1 1	0	0

- Molecule 4 is 6-chloro-2-cyclopropyl-5-methylpyrimidin-4-amine (CCD ID: 4XV) (formula: C₈H₁₀ClN₃).

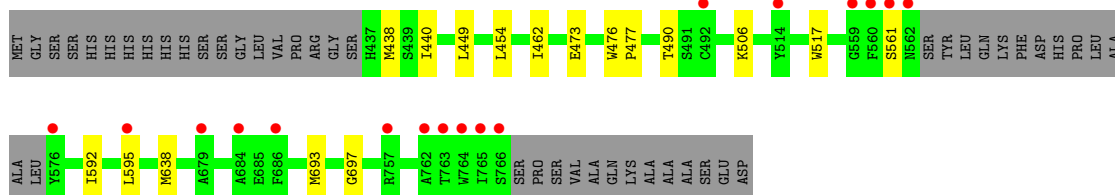
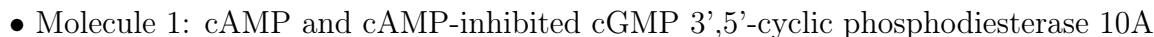


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	Cl	N	0	0
			12	8	1	3		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	285	Total	O	0	0
			285	285		
5	B	290	Total	O	0	0
			290	290		

- Molecule 1: cAMP and cAMP-inhibited cGMP 3',5'-cyclic phosphodiesterase 10A



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	49.65Å 82.04Å 152.86Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	22.84 – 1.56 22.84 – 1.56	Depositor EDS
% Data completeness (in resolution range)	99.0 (22.84-1.56) 99.0 (22.84-1.56)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.55 (at 1.56Å)	Xtriage
Refinement program	BUSTER-TNT	Depositor
R, R_{free}	0.170 , 0.196 0.171 , 0.197	Depositor DCC
R_{free} test set	4456 reflections (4.96%)	wwPDB-VP
Wilson B-factor (Å ²)	16.5	Xtriage
Anisotropy	0.443	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 41.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	5776	wwPDB-VP
Average B, all atoms (Å ²)	22.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.83% 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](#)

Bond lengths and bond angles in the following residue types are not validated in this section: ZN, MG, 4XV

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	0.79	0/2693	1.03	0/3649
1	B	0.80	2/2629 (0.1%)	1.03	2/3561 (0.1%)
All	All	0.79	2/5322 (0.0%)	1.03	2/7210 (0.0%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	693	MET	SD-CE	-5.66	1.65	1.79
1	B	638	MET	SD-CE	-5.49	1.65	1.79

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	561	SER	CA-C-N	5.13	130.93	121.70
1	B	561	SER	C-N-CA	5.13	130.93	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	2625	0	2574	12	0
1	B	2560	0	2520	7	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	12	0	9	0	0
5	A	285	0	0	1	0
5	B	290	0	0	0	0
All	All	5776	0	5103	18	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 2.

All (18) 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:B:440:ILE:HG22	1:B:595:LEU:HD13	1.75	0.67
1:A:703[A]:MET:HE1	1:B:697:GLY:HA3	1.90	0.52
1:A:717:LEU:HD12	1:A:749:LEU:HD11	1.94	0.50
1:B:473:GLU:HA	1:B:476:TRP:CE2	2.47	0.50
1:A:473:GLU:HA	1:A:476:TRP:CE2	2.48	0.49
1:A:438:MET:HE2	1:A:592:ILE:HG13	1.93	0.49
1:B:506:LYS:HZ3	1:B:517:TRP:CD1	2.31	0.49
1:A:556:ASP:HB2	1:A:588:GLN:HE21	1.78	0.47
1:B:438:MET:HE2	1:B:592:ILE:HG13	1.96	0.47
1:A:438:MET:HE1	1:A:588:GLN:NE2	2.29	0.47
1:B:454:LEU:HD21	1:B:462:ILE:HD12	1.97	0.47
1:A:706:ARG:O	1:A:709:LYS:HG3	2.16	0.46
1:A:454:LEU:HD21	1:A:462:ILE:HD12	2.01	0.43
1:A:535:HIS:HE1	5:A:1105:HOH:O	2.02	0.42
1:A:449:LEU:HD13	1:A:477:PRO:HB2	2.04	0.40
1:A:717:LEU:HD12	1:A:749:LEU:CD1	2.51	0.40
1:B:449:LEU:HD13	1:B:477:PRO:HB2	2.04	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	324/362 (90%)	320 (99%)	4 (1%)	0	100	100
1	B	316/362 (87%)	311 (98%)	5 (2%)	0	100	100
All	All	640/724 (88%)	631 (99%)	9 (1%)	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	291/323 (90%)	291 (100%)	0	100	100
1	B	285/323 (88%)	284 (100%)	1 (0%)	84	73
All	All	576/646 (89%)	575 (100%)	1 (0%)	87	79

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	490	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	533	ASN
1	A	535	HIS

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Mol	Chain	Res	Type
1	A	588	GLN
1	A	751	GLN
1	B	649	GLN
1	B	733	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](#)

Of 5 ligands modelled in this entry, 4 are monoatomic - leaving 1 for Mogul analysis.

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$
4	4XV	A	803	-	11,13,13	1.17	1 (9%)	11,19,19	1.11	1 (9%)

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
4	4XV	A	803	-	-	0/4/6/6	0/2/2/2

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	803	4XV	C2-N5	2.79	1.41	1.34

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	803	4XV	C6-C1-C2	2.71	125.27	121.32

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

6.1 Protein, DNA and RNA chains

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	325/362 (89%)	0.07	19 (5%) 29 34	11, 18, 38, 66	1 (0%)
1	B	317/362 (87%)	0.20	17 (5%) 31 38	11, 19, 36, 75	3 (0%)
All	All	642/724 (88%)	0.14	36 (5%) 30 36	11, 19, 36, 75	4 (0%)

All (36) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	766	SER	4.7
1	A	761	THR	4.7
1	B	765	ILE	3.5
1	B	559	GLY	3.4
1	B	562	ASN	3.4
1	B	763	THR	3.2
1	B	576	TYR	3.2
1	B	762	ALA	3.2
1	A	568	PHE	3.1
1	B	514	TYR	3.0
1	A	696	LEU	3.0
1	B	560	PHE	3.0
1	A	437	HIS	2.9
1	B	561	SER	2.9
1	A	697	GLY	2.8
1	A	698	ILE	2.8
1	B	684	ALA	2.6
1	A	575	LEU	2.6
1	A	647	ASN	2.6
1	A	439	SER	2.5
1	A	458	LEU	2.5
1	B	686	PHE	2.4
1	A	438	MET	2.4
1	B	679	ALA	2.3

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Mol	Chain	Res	Type	RSRZ
1	A	457	ARG	2.3
1	A	455	PRO	2.3
1	A	452	PHE	2.3
1	B	764	TRP	2.2
1	A	607	SER	2.1
1	B	595	LEU	2.1
1	A	540	ASP	2.1
1	B	492	CYS	2.1
1	A	699	GLN	2.1
1	A	456	VAL	2.0
1	A	646	LEU	2.0
1	B	757	ARG	2.0

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($\text{\AA}^2$)	Q<0.9
4	4XV	A	803	12/12	0.92	0.08	18,21,24,30	0
3	MG	B	802	1/1	0.99	0.02	15,15,15,15	0
2	ZN	B	801	1/1	0.99	0.12	24,24,24,24	0
2	ZN	A	801	1/1	1.00	0.09	19,19,19,19	0
3	MG	A	802	1/1	1.00	0.02	12,12,12,12	0

6.5 Other polymers [i](#)

There are no such residues in this entry.