



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 09:25 AM UTC

PDB ID : 9CBF / pdb_00009cbf
Title : Crystal Structure of Danio rerio Histone Deacetylase 10 in Complex with m-Aminomethyl Phenylthioketone
Authors : Goulart Stollmaier, J.; Christianson, D.W.
Deposited on : 2024-06-19
Resolution : 2.26 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)
Xtrriage (Phenix) : 2.0
EDS : 3.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
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

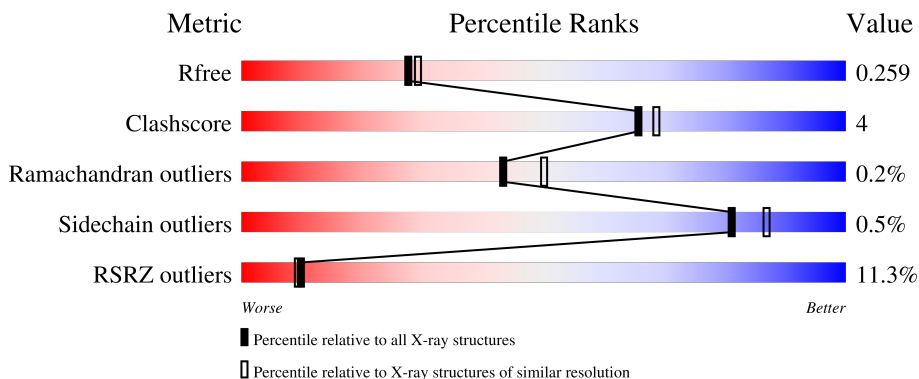
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.26 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	1898 (2.26-2.26)
Clashscore	190562	2005 (2.26-2.26)
Ramachandran outliers	187476	1965 (2.26-2.26)
Sidechain outliers	187428	1966 (2.26-2.26)
RSRZ outliers	180081	1898 (2.26-2.26)

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	676	

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 4460 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 Polyamine deacetylase HDAC10.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	609	4409	2808	751	817	33	0	0	0

There are 11 discrepancies between the modelled and reference sequences:

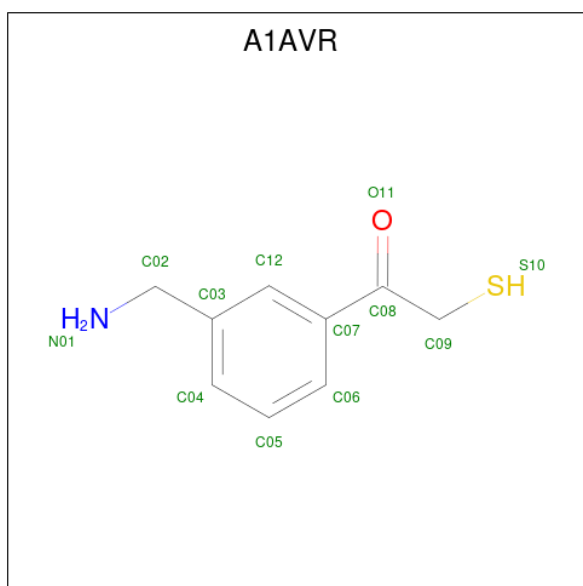
Chain	Residue	Modelled	Actual	Comment	Reference
A	1	ALA	-	expression tag	UNP F1QCV2
A	24	GLU	ALA	conflict	UNP F1QCV2
A	94	ALA	ASP	conflict	UNP F1QCV2
A	154	PHE	ILE	conflict	UNP F1QCV2
A	548	THR	SER	conflict	UNP F1QCV2
A	586	GLU	GLY	conflict	UNP F1QCV2
A	593	ARG	GLY	conflict	UNP F1QCV2
A	596	ARG	THR	conflict	UNP F1QCV2
A	613	MET	THR	conflict	UNP F1QCV2
A	646	PRO	LEU	conflict	UNP F1QCV2
A	676	TRP	-	expression tag	UNP F1QCV2

- Molecule 2 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: C₂H₆O₂).



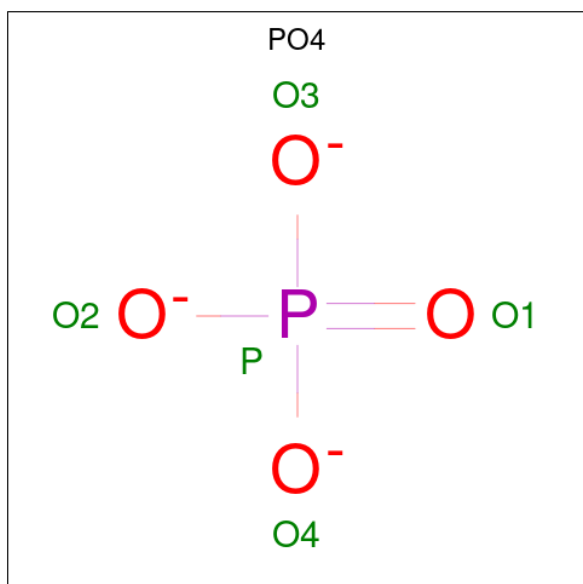
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0

- Molecule 3 is 1-[3-(aminomethyl)phenyl]-2-sulfanylethan-1-one (CCD ID: A1AVR) (formula: C₉H₁₁NOS) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
3	A	1	12	9	1	1	1	0	0

- Molecule 4 is PHOSPHATE ION (CCD ID: PO4) (formula: O₄P).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	O	P		
4	A	1	5	4	1	0	0
4	A	1	5	4	1	0	0

- Molecule 5 is POTASSIUM ION (CCD ID: K) (formula: K).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	K		
5	A	2	2	2	0	0

- Molecule 6 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Zn		
6	A	1	1	1	0	0

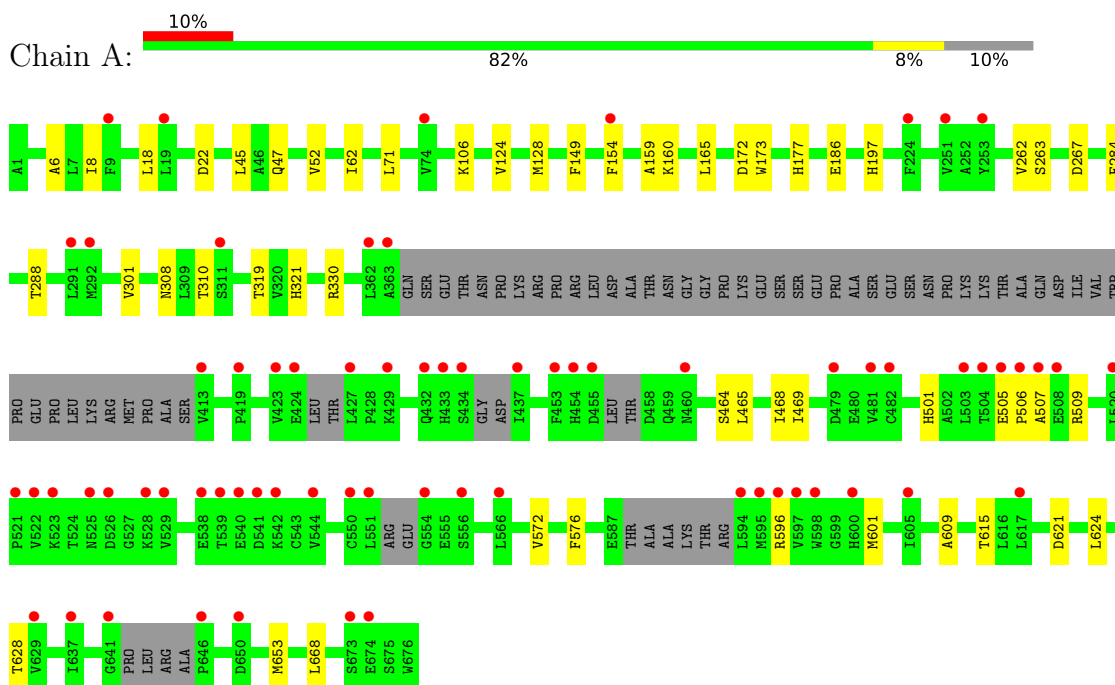
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	14	Total	O	0	0
			14	14		

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: Polyamine deacetylase HDAC10



4 Data and refinement statistics i

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	80.41Å 80.41Å 236.95Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	34.35 – 2.26 34.35 – 2.26	Depositor EDS
% Data completeness (in resolution range)	91.6 (34.35-2.26) 91.5 (34.35-2.26)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.13 (at 2.27Å)	Xtrriage
Refinement program	PHENIX 1.21rc1_5156	Depositor
R, R_{free}	0.235 , 0.258 0.236 , 0.259	Depositor DCC
R_{free} test set	1982 reflections (4.62%)	wwPDB-VP
Wilson B-factor (Å ²)	56.2	Xtrriage
Anisotropy	0.353	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.28 , 41.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.036 for -h,-k,l	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	4460	wwPDB-VP
Average B, all atoms (Å ²)	77.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.12% 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, K, EDO, A1AVR, PO4

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	0.09	0/4504	0.27	0/6153

There are no bond length outliers.

There are no bond angle outliers.

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	4409	0	4053	32	0
2	A	12	0	18	0	0
3	A	12	0	0	0	0
4	A	10	0	0	0	0
5	A	2	0	0	0	0
6	A	1	0	0	0	0
7	A	14	0	0	0	0
All	All	4460	0	4071	32	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 4.

All (32) 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:288:THR:HG21	1:A:319:THR:HG23	1.60	0.84
1:A:330:ARG:HD3	1:A:609:ALA:HA	1.82	0.62
1:A:173:TRP:HH2	1:A:288:THR:HG22	1.65	0.62
1:A:572:VAL:HG23	1:A:668:LEU:HD21	1.86	0.57
1:A:615:THR:HG21	1:A:628:THR:HG21	1.92	0.52
1:A:159:ALA:HB1	1:A:165:LEU:HD12	1.91	0.51
1:A:47:GLN:OE1	1:A:47:GLN:N	2.41	0.48
1:A:284:PHE:O	1:A:288:THR:HG23	2.13	0.47
1:A:45:LEU:HD21	1:A:321:HIS:CE1	2.50	0.47
1:A:177:HIS:HB2	1:A:197:HIS:CG	2.49	0.47
1:A:172:ASP:HA	1:A:263:SER:HB2	1.97	0.47
1:A:149:PHE:HB3	1:A:154:PHE:CE2	2.50	0.46
1:A:653:MET:HE3	1:A:653:MET:HB3	1.92	0.45
1:A:308:ASN:C	1:A:310:THR:H	2.25	0.44
1:A:509:ARG:HB3	1:A:576:PHE:CZ	2.53	0.43
1:A:596:ARG:HD3	1:A:596:ARG:HA	1.82	0.43
1:A:8:ILE:HG13	1:A:52:VAL:HB	1.99	0.43
1:A:464:SER:O	1:A:468:ILE:HG12	2.19	0.43
1:A:62:ILE:HD11	1:A:106:LYS:HG2	2.00	0.43
1:A:6:ALA:HB2	1:A:124:VAL:HG11	2.00	0.43
1:A:173:TRP:CH2	1:A:288:THR:HG22	2.48	0.43
1:A:469:ILE:HG23	1:A:501:HIS:CE1	2.53	0.43
1:A:18:LEU:HD21	1:A:22:ASP:HB3	2.00	0.42
1:A:128:MET:HE2	1:A:301:VAL:HG11	2.01	0.42
1:A:160:LYS:HE2	1:A:160:LYS:HB3	1.85	0.42
1:A:267:ASP:OD1	1:A:267:ASP:N	2.50	0.42
1:A:505:GLU:O	1:A:507:ALA:N	2.52	0.42
1:A:465:LEU:O	1:A:469:ILE:HG12	2.20	0.42
1:A:149:PHE:HB3	1:A:154:PHE:HE2	1.83	0.41
1:A:621:ASP:HB3	1:A:624:LEU:HB3	2.01	0.41
1:A:62:ILE:HG21	1:A:71:LEU:HD13	2.03	0.41
1:A:173:TRP:CH2	1:A:262:VAL:HG11	2.57	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	593/676 (88%)	565 (95%)	27 (5%)	1 (0%)	43 50

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	506	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	427/580 (74%)	425 (100%)	2 (0%)	81 87

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	186	GLU
1	A	601	MET

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	207	ASN
1	A	350	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](#)

Of 9 ligands modelled in this entry, 3 are monoatomic - leaving 6 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
3	A1AVR	A	704	6	12,12,12	2.55	6 (50%)	15,15,15	0.60	0
2	EDO	A	701	-	3,3,3	0.25	0	2,2,2	0.34	0
2	EDO	A	703	-	3,3,3	0.24	0	2,2,2	0.34	0
2	EDO	A	702	-	3,3,3	0.25	0	2,2,2	0.33	0
4	PO4	A	705	-	4,4,4	1.57	1 (25%)	6,6,6	0.48	0
4	PO4	A	706	-	4,4,4	1.41	1 (25%)	6,6,6	0.54	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
3	A1AVR	A	704	6	-	0/6/8/8	0/1/1/1
2	EDO	A	702	-	-	0/1/1/1	-
2	EDO	A	701	-	-	0/1/1/1	-
2	EDO	A	703	-	-	0/1/1/1	-

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	704	A1AVR	C12-C07	4.85	1.46	1.39
3	A	704	A1AVR	C07-C08	4.63	1.56	1.49
3	A	704	A1AVR	C09-C08	-3.02	1.47	1.51
4	A	705	PO4	P-O1	2.75	1.57	1.50
4	A	706	PO4	P-O1	2.49	1.56	1.50
3	A	704	A1AVR	O11-C08	-2.32	1.18	1.22
3	A	704	A1AVR	C06-C07	-2.31	1.35	1.39
3	A	704	A1AVR	C09-S10	2.25	1.86	1.82

There are no bond angle outliers.

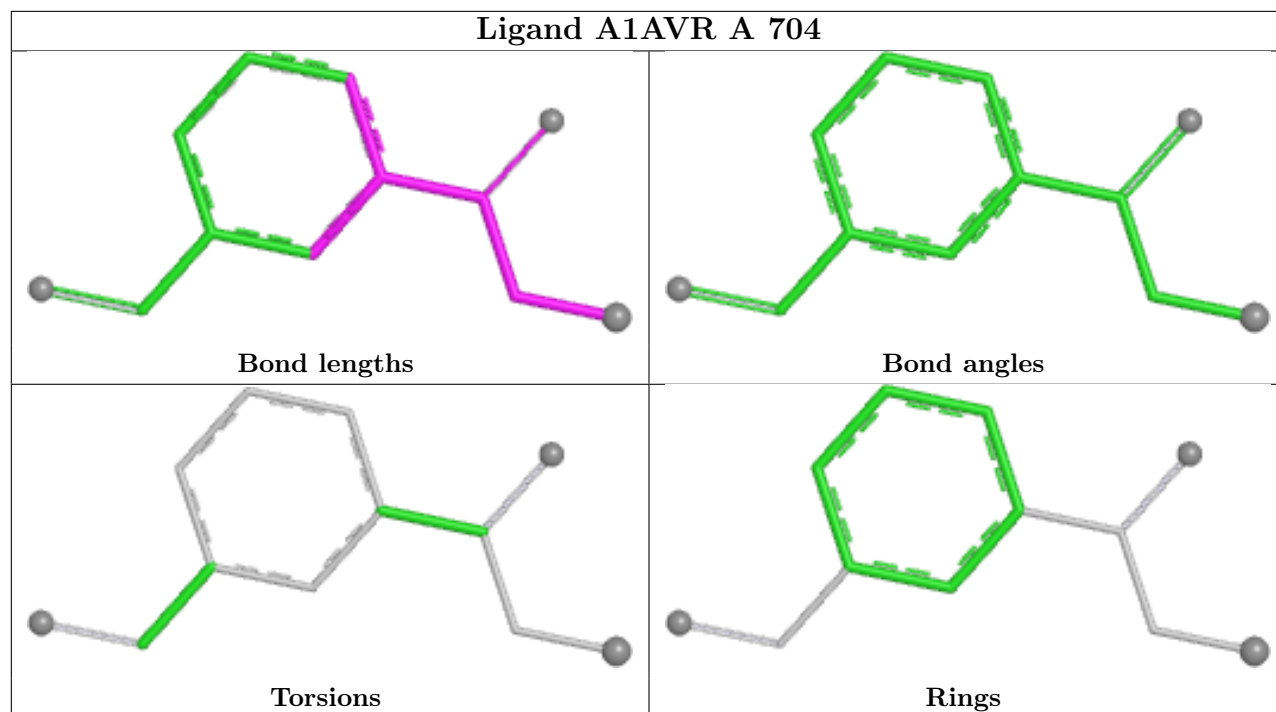
There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.



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	609/676 (90%)	0.94	69 (11%) 10 9	57, 72, 112, 159	0

All (69) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	434	SER	6.9
1	A	594	LEU	4.9
1	A	646	PRO	4.6
1	A	551	LEU	4.3
1	A	437	ILE	4.1
1	A	506	PRO	4.1
1	A	637	ILE	3.8
1	A	595	MET	3.6
1	A	424	GLU	3.6
1	A	544	VAL	3.6
1	A	617	LEU	3.5
1	A	432	GLN	3.5
1	A	455	ASP	3.5
1	A	503	LEU	3.4
1	A	539	THR	3.4
1	A	154	PHE	3.3
1	A	504	THR	3.3
1	A	629	VAL	3.3
1	A	433	HIS	3.2
1	A	596	ARG	3.2
1	A	253	TYR	3.2
1	A	605	ILE	3.1
1	A	542	LYS	3.1
1	A	556	SER	3.0
1	A	453	PHE	3.0
1	A	522	VAL	3.0
1	A	674	GLU	2.9

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Mol	Chain	Res	Type	RSRZ
1	A	597	VAL	2.8
1	A	541	ASP	2.8
1	A	224	PHE	2.8
1	A	505	GLU	2.8
1	A	9	PHE	2.8
1	A	454	HIS	2.7
1	A	413	VAL	2.7
1	A	520	LEU	2.7
1	A	528	LYS	2.6
1	A	362	LEU	2.6
1	A	507	ALA	2.6
1	A	525	ASN	2.6
1	A	311	SER	2.6
1	A	429	LYS	2.6
1	A	482	CYS	2.5
1	A	521	PRO	2.5
1	A	523	LYS	2.5
1	A	538	GLU	2.4
1	A	74	VAL	2.4
1	A	529	VAL	2.4
1	A	291	LEU	2.4
1	A	566	LEU	2.4
1	A	460	ASN	2.4
1	A	600	HIS	2.4
1	A	554	GLY	2.3
1	A	673	SER	2.3
1	A	481	VAL	2.3
1	A	427	LEU	2.3
1	A	550	CYS	2.3
1	A	479	ASP	2.2
1	A	540	GLU	2.2
1	A	251	VAL	2.2
1	A	419	PRO	2.2
1	A	292	MET	2.2
1	A	508	GLU	2.2
1	A	598	TRP	2.2
1	A	423	VAL	2.1
1	A	650	ASP	2.1
1	A	363	ALA	2.1
1	A	641	GLY	2.1
1	A	526	ASP	2.0
1	A	19	LEU	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](#)

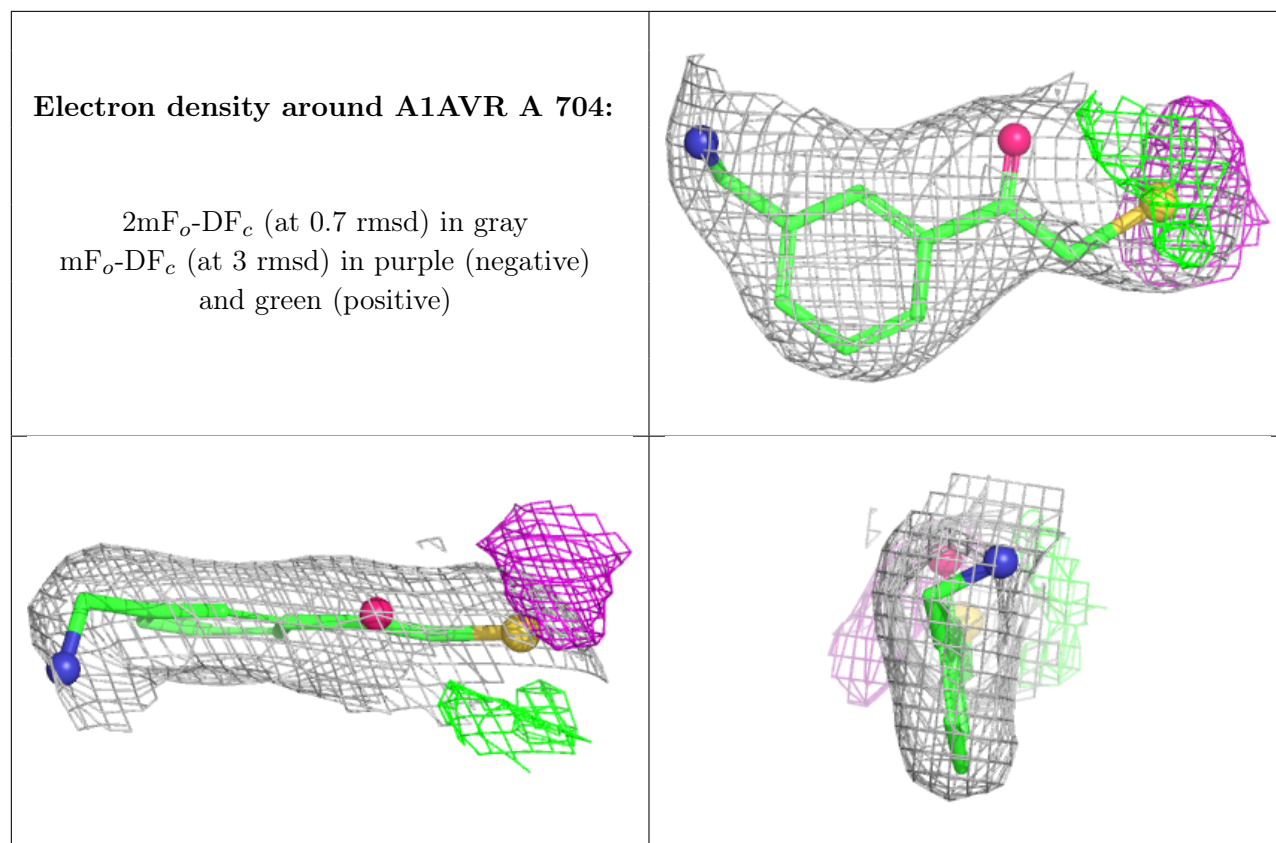
There are no oligosaccharides in this entry.

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(\AA^2)	Q<0.9
2	EDO	A	702	4/4	0.75	0.23	71,74,74,74	0
2	EDO	A	703	4/4	0.78	0.22	75,76,77,78	0
2	EDO	A	701	4/4	0.85	0.18	76,79,79,80	0
3	A1AVR	A	704	12/12	0.92	0.13	62,64,66,69	0
4	PO4	A	705	5/5	0.93	0.09	62,65,68,72	0
4	PO4	A	706	5/5	0.93	0.12	59,62,65,68	0
5	K	A	708	1/1	0.98	0.07	68,68,68,68	0
5	K	A	707	1/1	0.99	0.03	62,62,62,62	0
6	ZN	A	709	1/1	0.99	0.07	70,70,70,70	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.



6.5 Other polymers [i](#)

There are no such residues in this entry.