



# wwPDB X-ray Structure Validation Summary Report ⓘ

Jun 15, 2024 – 11:33 PM EDT

PDB ID : 2BXT  
Title : Design and Discovery of Novel, Potent Thrombin Inhibitors with a Solubilizing Cationic P1-P2-Linker  
Authors : Bulat, S.; Bosio, S.; Grabowski, E.; Papadopoulos, M.A.; Cerezo-Galvez, S.; Rosenbaum, C.; Matassa, V.G.; Ott, I.; Metz, G.; Schamberger, J.; Sekul, R.; Feurer, A.  
Deposited on : 2005-07-27  
Resolution : 1.83 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](mailto: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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtrriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.37.1

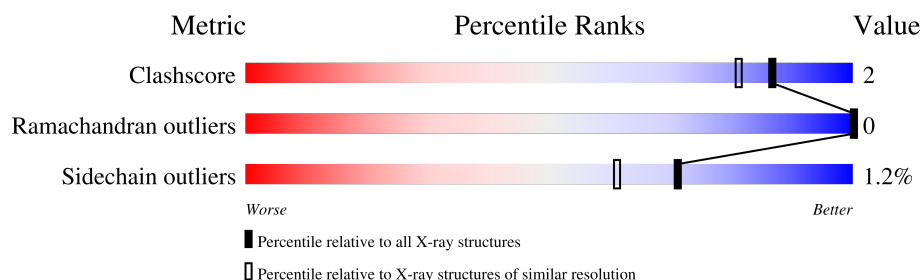
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.83 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	141614	4233 (1.86-1.82)
Ramachandran outliers	138981	4185 (1.86-1.82)
Sidechain outliers	138945	4186 (1.86-1.82)

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  $\geq 3$ , 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	H	259	<div> <div></div> <div>91%</div> <div>6% ..</div> </div>
2	I	11	<div> <div></div> <div>82%</div> <div>18%</div> </div>
3	L	36	<div> <div></div> <div>78%</div> <div>22%</div> </div>

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	C2D	H	1246	X	-	-	-

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 2558 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 ALPHA THROMBIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	H	253	Total	C	N	O	S	0	0	2
			2036	1298	362	362	14			

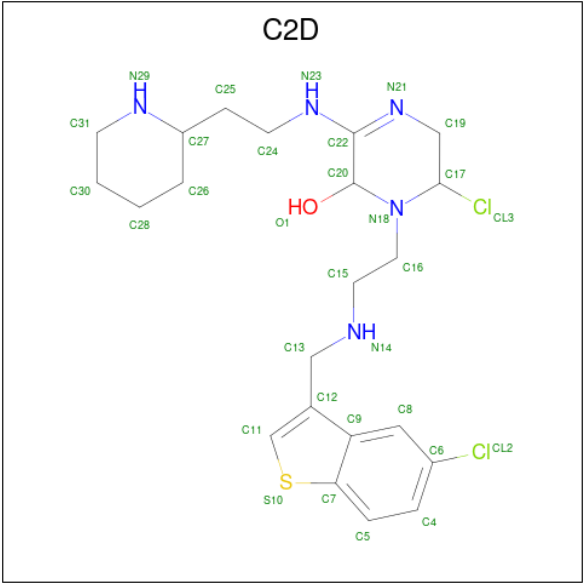
- Molecule 2 is a protein called HIRUDIN VARIANT-2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	I	11	Total	C	N	O	S	0	0	0
			99	61	11	26	1			

- Molecule 3 is a protein called ALPHA THROMBIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	L	28	Total	C	N	O	S	0	0	1
			223	140	37	45	1			

- Molecule 4 is 6-CHLORO-1-(2-[[[(5-CHLORO-1-BENZOTHIEN-3-YL)METHYL]AMINO}ETHYL)-3-[(2-PYRIDIN-2-YLETHYL)AMINO]-1,4-DIHYDROPYRAZIN-2-OL (three-letter code: C2D) (formula: C<sub>22</sub>H<sub>31</sub>Cl<sub>2</sub>N<sub>5</sub>OS).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	H	1	Total	C	Cl	N	O	S	
			31	22	2	5	1	1	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	H	145	Total	O		
			145	145	0	0
5	I	8	Total	O		
			8	8	0	0
5	L	16	Total	O		
			16	16	0	0

### 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: ALPHA THROMBIN

Chain H:  91% 6% ..



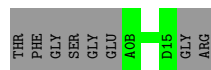
- Molecule 2: HIRUDIN VARIANT-2

Chain I:  82% 18%



- Molecule 3: ALPHA THROMBIN

Chain L:  78% 22%



## 4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	70.50Å 71.92Å 72.52Å 90.00° 100.35° 90.00°	Depositor
Resolution (Å)	20.00 – 1.83	Depositor
% Data completeness (in resolution range)	(Not available) (20.00-1.83)	Depositor
$R_{merge}$	0.05	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	CNX 2002	Depositor
R, $R_{free}$	0.207 , 0.225	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2558	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	29.0	wwPDB-VP

## 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: C2D, TYS

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	H	0.64	2/2088 (0.1%)	0.60	0/2821
2	I	0.43	0/83	0.41	0/108
3	L	0.54	0/225	0.60	0/300
All	All	0.62	2/2396 (0.1%)	0.59	0/3229

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	H	217	GLU	C-N	21.29	1.71	1.33
1	H	245	PHE	C-N	-5.33	1.23	1.33

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	H	2036	0	2013	10	0
2	I	99	0	77	0	0
3	L	223	0	225	0	0
4	H	31	0	27	0	0
5	H	145	0	0	0	0
5	I	8	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	L	16	0	0	0	0
All	All	2558	0	2342	10	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.

The worst 5 of 10 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:H:217:GLU:C	1:H:219:GLY:N	1.71	1.42
1:H:217:GLU:CA	1:H:219:GLY:N	2.64	0.60
1:H:217:GLU:C	1:H:219:GLY:CA	2.69	0.59
1:H:139:THR:HG22	1:H:157:VAL:HG22	1.87	0.56
1:H:32:MET:HG3	1:H:40:LEU:HD13	1.95	0.48

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	H	249/259 (96%)	239 (96%)	10 (4%)	0	100	100
2	I	8/11 (73%)	8 (100%)	0	0	100	100
3	L	26/36 (72%)	25 (96%)	1 (4%)	0	100	100
All	All	283/306 (92%)	272 (96%)	11 (4%)	0	100	100

There are no Ramachandran outliers to report.

### 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	H	220/225 (98%)	218 (99%)	2 (1%)	78	71
2	I	9/9 (100%)	8 (89%)	1 (11%)	6	1
3	L	25/31 (81%)	25 (100%)	0	100	100
All	All	254/265 (96%)	251 (99%)	3 (1%)	71	61

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	H	182	CYS
1	H	204(B)	ASN
2	I	12	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	H	78	ASN
1	H	156	GLN
1	H	204(B)	ASN
1	H	244	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](#)

1 non-standard protein/DNA/RNA residue 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	$\# Z  > 2$
2	TYS	I	18	2	15,16,17	1.11	1 (6%)	15,22,24	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
2	TYS	I	18	2	-	0/10/11/13	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	I	18	TYS	OH-CZ	-3.14	1.37	1.42

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.

## 5.5 Carbohydrates [i](#)

There are no monosaccharides 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
4	C2D	H	1246	-	27,34,34	4.07	15 (55%)	22,46,46	3.72	12 (54%)

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	C2D	H	1246	-	3/3/5/8	4/10/38/38	0/4/4/4

The worst 5 of 15 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	H	1246	C2D	C7-S10	-11.84	1.64	1.74
4	H	1246	C2D	O1-C20	-8.96	1.23	1.39
4	H	1246	C2D	C11-S10	-7.43	1.61	1.70
4	H	1246	C2D	C26-C27	-4.94	1.40	1.52
4	H	1246	C2D	C11-C12	4.90	1.40	1.37

The worst 5 of 12 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	H	1246	C2D	C19-C17-CL3	12.48	120.44	108.79
4	H	1246	C2D	C25-C27-C26	5.61	122.32	112.48
4	H	1246	C2D	C30-C28-C26	4.85	121.39	111.42
4	H	1246	C2D	C28-C26-C27	4.49	119.14	111.09
4	H	1246	C2D	C13-C12-C9	-3.72	120.89	126.40

All (3) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
4	H	1246	C2D	C20
4	H	1246	C2D	C17
4	H	1246	C2D	C27

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	H	1246	C2D	C24-C25-C27-N29
4	H	1246	C2D	C16-C15-N14-C13
4	H	1246	C2D	N14-C15-C16-N18

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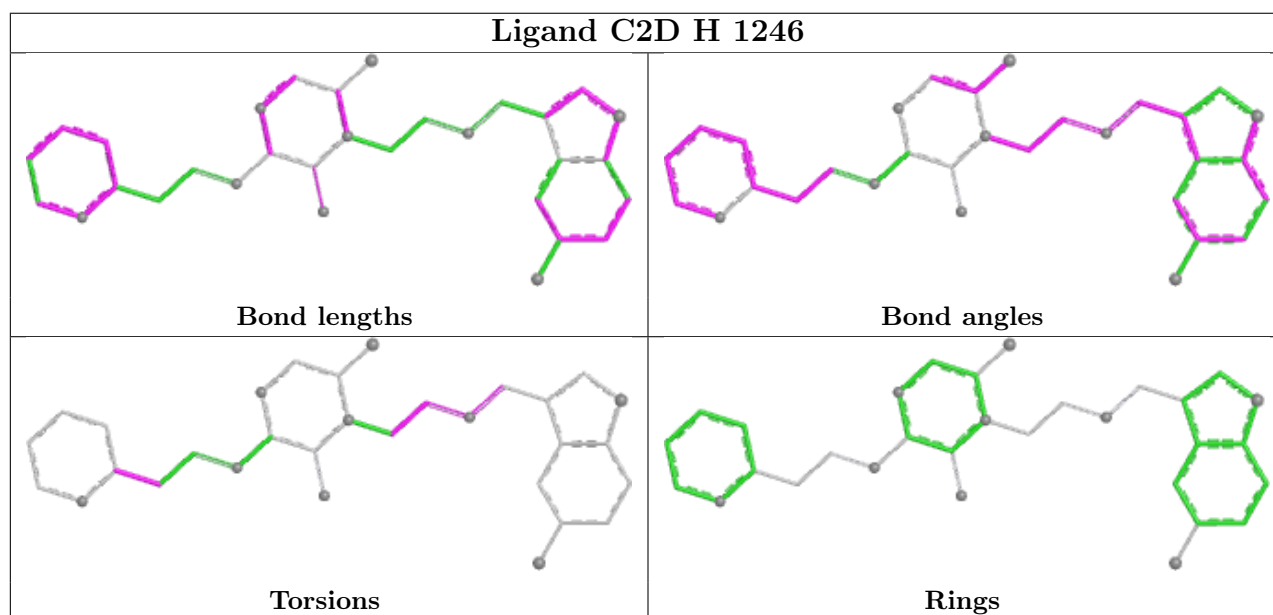
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Mol	Chain	Res	Type	Atoms
4	H	1246	C2D	C12-C13-N14-C15

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](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	H	1

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	H	217:GLU	C	219:GLY	N	1.71

## 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.