



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2026 – 11:25 PM UTC

PDB ID : 2RTO / pdb\_00002rto  
Title : STREPTAVIDIN-2-IMINOBIOTIN COMPLEX, PH 2.6, SPACE GROUP I222  
Authors : Katz, B.A.  
Deposited on : 1997-09-11  
Resolution : 1.58 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 : 4-5-2 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

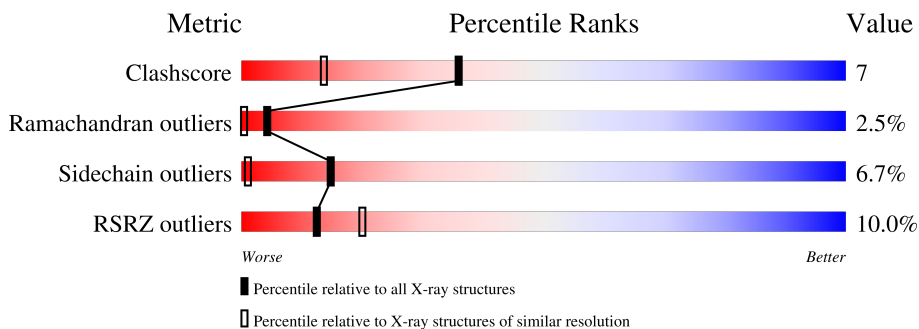
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.58 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	1105 (1.58-1.58)
Ramachandran outliers	187476	1082 (1.58-1.58)
Sidechain outliers	187428	1081 (1.58-1.58)
RSRZ outliers	180081	1094 (1.58-1.58)

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  $\leq 5\%$ . 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	B	135	
1	D	135	

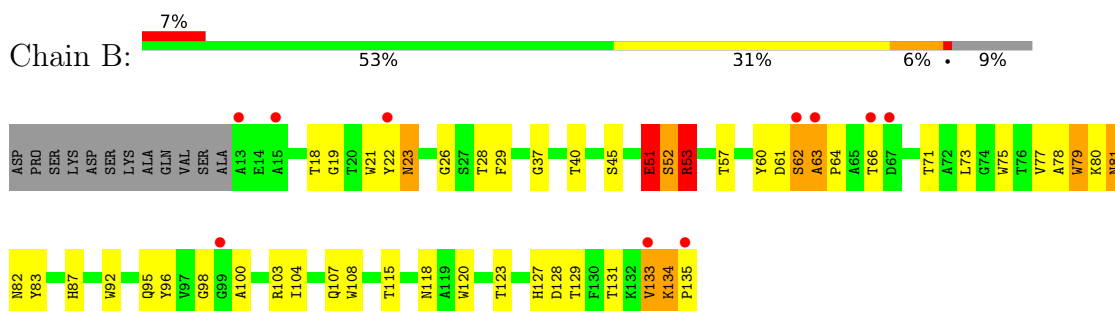


<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>			<b>ZeroOcc</b>	<b>AltConf</b>
3	B	45	Total	H	O	0	9
			127	82	45		
3	D	57	Total	H	O	0	5
			171	114	57		

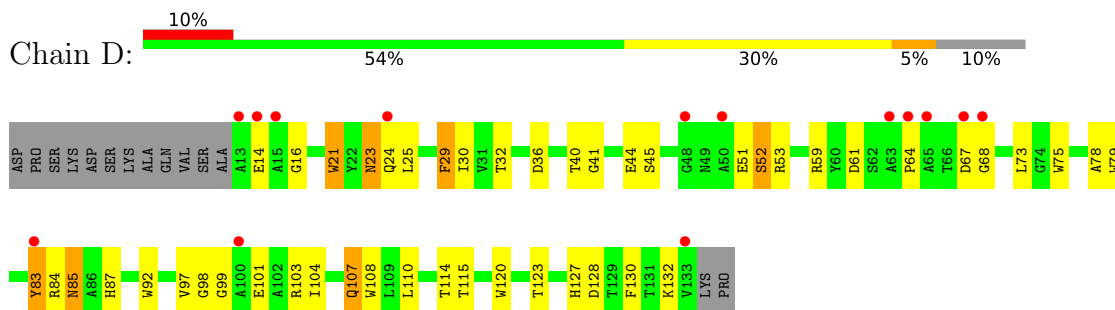
### 3 Residue-property plots [i](#)

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: STREPTAVIDIN



- Molecule 1: STREPTAVIDIN



## 4 Data and refinement statistics

Property	Value	Source
Space group	I 2 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	95.06Å 105.84Å 48.01Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	7.50 – 1.58 7.50 – 1.58	Depositor EDS
% Data completeness (in resolution range)	71.0 (7.50-1.58) 70.3 (7.50-1.58)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.27 (at 1.30Å)	Xtrriage
Refinement program	X-PLOR	Depositor
R, $R_{free}$	0.208 , 0.253 0.233 , (Not available)	Depositor DCC
$R_{free}$ test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	10.4	Xtrriage
Anisotropy	0.408	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.29 , 65.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	4198	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	32.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 12.65% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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: IMI

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	B	1.90	17/1043 (1.6%)	1.82	36/1428 (2.5%)
1	D	1.86	11/1014 (1.1%)	1.86	32/1389 (2.3%)
All	All	1.88	28/2057 (1.4%)	1.84	68/2817 (2.4%)

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
1	B	0	4
1	D	0	2
All	All	0	6

The worst 5 of 28 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	127	HIS	CG-ND1	-6.62	1.30	1.38
1	D	45	SER	CA-CB	6.59	1.63	1.53
1	D	127	HIS	CD2-NE2	-6.53	1.30	1.37
1	B	87[A]	HIS	CD2-NE2	-6.01	1.31	1.37
1	B	87[B]	HIS	CD2-NE2	-6.01	1.31	1.37

The worst 5 of 68 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	78	ALA	N-CA-C	-9.91	93.51	109.76
1	B	78	ALA	N-CA-C	-8.87	94.80	109.07
1	B	118	ASN	CA-CB-CG	-8.74	103.86	112.60
1	D	123	THR	N-CA-C	8.56	122.47	108.52

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	115	THR	N-CA-C	-8.42	98.06	110.52

There are no chirality outliers.

5 of 6 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	103	ARG	Sidechain
1	B	134	LYS	Peptide
1	B	53	ARG	Sidechain
1	B	63[A]	ALA	Peptide
1	D	53	ARG	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	B	1004	939	927	16	6
1	D	981	910	901	14	0
2	B	16	17	15	2	0
2	D	16	17	15	1	0
3	B	45	82	0	0	3
3	D	57	114	0	0	4
All	All	2119	2079	1858	27	8

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 7.

The worst 5 of 27 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:22[B]:TYR:CE1	1:B:131:THR:HB	2.12	0.83
1:B:37:GLY:HA2	1:B:60[A]:TYR:CE1	2.36	0.60
1:D:51:GLU:HB3	1:D:84:ARG:HG3	1.90	0.53
1:B:95:GLN:NE2	1:D:114:THR:H	2.07	0.51
1:B:133:VAL:HG22	1:B:134:LYS:HG3	1.92	0.51

The worst 5 of 8 symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:B:1491[C]:HOH:O	3:B:1491[C]:HOH:O[3_655]	0.91	1.29
3:B:1464[C]:HOH:O	3:B:1464[C]:HOH:O[3_655]	1.42	0.78
1:B:28:THR:OG1	3:D:952:HOH:H1[6_554]	1.14	0.46
1:B:80:LYS:HZ2	3:B:966:HOH:H2[6_554]	1.23	0.37
1:B:53:ARG:O	3:D:1478:HOH:H1[6_554]	1.25	0.35

## 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	B	134/135 (99%)	129 (96%)	2 (2%)	3 (2%)	5	0
1	D	131/135 (97%)	122 (93%)	4 (3%)	5 (4%)	2	0
All	All	265/270 (98%)	251 (95%)	6 (2%)	8 (3%)	4	0

5 of 8 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	52	SER
1	D	16	GLY
1	D	52	SER
1	B	64[A]	PRO
1	B	64[B]	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	B	100/100 (100%)	92 (92%)	8 (8%)	11	0
1	D	97/100 (97%)	89 (92%)	8 (8%)	10	0
All	All	197/200 (98%)	181 (92%)	16 (8%)	15	0

5 of 16 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	107[A]	GLN
1	D	101	GLU
1	D	29[A]	PHE
1	D	97	VAL
1	B	133	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	95	GLN
1	B	127	HIS

### 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](#)

2 ligands 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
2	IMI	B	300	-	16,17,17	1.69	5 (31%)	19,23,23	2.42	5 (26%)
2	IMI	D	300	-	16,17,17	1.73	5 (31%)	19,23,23	2.37	6 (31%)

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	IMI	B	300	-	-	3/7/28/28	0/2/2/2
2	IMI	D	300	-	-	3/7/28/28	0/2/2/2

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	300	IMI	C5-N1	2.92	1.50	1.46
2	B	300	IMI	C3-N1	-2.89	1.30	1.35
2	D	300	IMI	C3-N2	-2.86	1.30	1.35
2	B	300	IMI	C3-N2	-2.77	1.30	1.35
2	D	300	IMI	O12-C11	-2.68	1.22	1.30

The worst 5 of 11 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	300	IMI	C5-C6-S1	6.61	115.16	106.06
2	D	300	IMI	C5-C6-S1	5.70	113.92	106.06
2	D	300	IMI	C4-C2-S1	5.32	111.07	105.03
2	B	300	IMI	C4-C2-S1	5.17	110.90	105.03
2	D	300	IMI	N1-C3-N2	3.27	112.53	109.21

There are no chirality outliers.

5 of 6 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	D	300	IMI	C4-C2-C7-C8
2	B	300	IMI	C11-C10-C9-C8
2	D	300	IMI	C9-C10-C11-O12

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Mol	Chain	Res	Type	Atoms
2	D	300	IMI	C9-C10-C11-O11
2	B	300	IMI	C9-C10-C11-O12

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	300	IMI	2	0
2	D	300	IMI	1	0

## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	B	120/135 (88%)	0.34	10 (8%) 17 26	7, 24, 44, 63	22 (18%)
1	D	119/135 (88%)	0.48	14 (11%) 9 15	3, 25, 74, 99	21 (17%)
All	All	239/270 (88%)	0.41	24 (10%) 12 20	3, 24, 60, 99	43 (17%)

The worst 5 of 24 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	15	ALA	4.8
1	D	64[A]	PRO	4.6
1	D	63[A]	ALA	4.6
1	D	14	GLU	4.4
1	B	62[A]	SER	4.2

### 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, 95<sup>th</sup> 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
2	IMI	B	300	16/16	0.90	0.08	35,39,49,55	0
2	IMI	D	300	16/16	0.93	0.07	26,36,43,46	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.