



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 20, 2026 – 06:28 AM UTC

PDB ID : 7TH3 / pdb_00007th3
Title : Single-domain VHH intrabodies neutralize ricin toxin
Authors : Rudolph, M.J.
Deposited on : 2022-01-10
Resolution : 2.29 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
Xtrriage (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

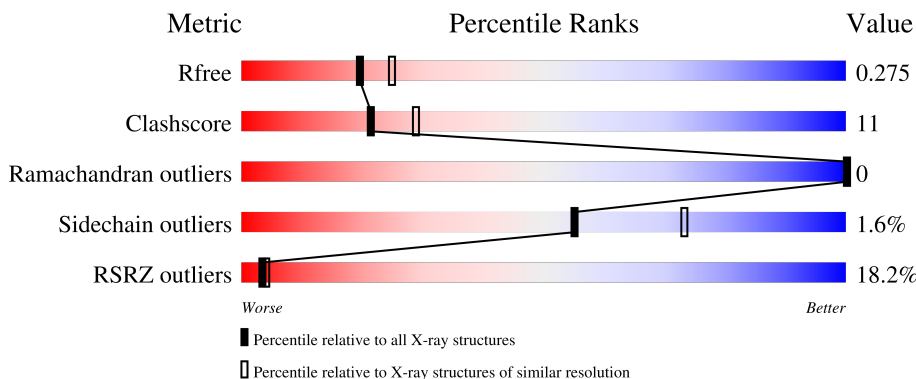
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.29 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	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	267	
2	B	129	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3173 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 Ricin chain A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	257	2032	1287	359	381	5	0	0	0

- Molecule 2 is a protein called VHH antibody.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	117	902	564	154	178	6	0	1	0

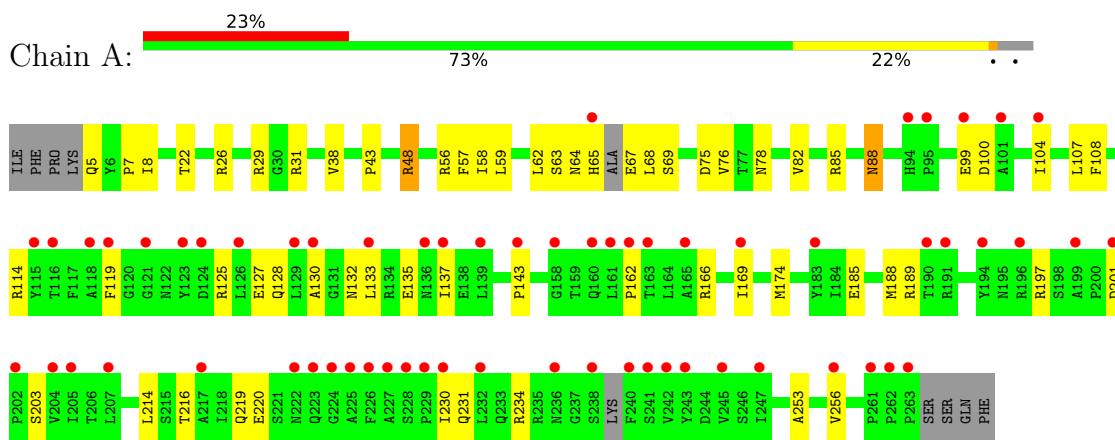
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	161	Total	O	0	0
			161	161		
3	B	78	Total	O	0	0
			78	78		

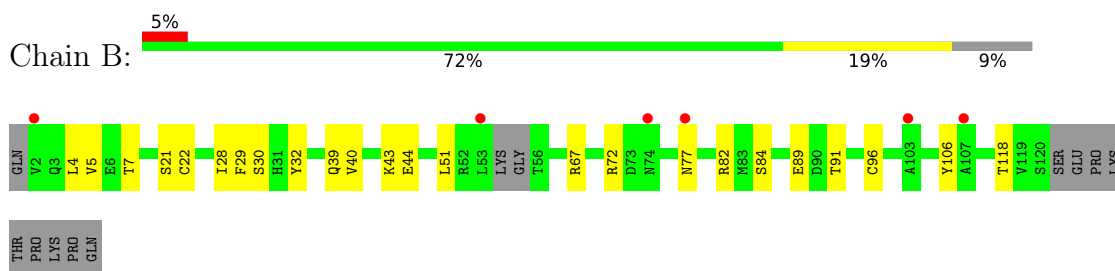
3 Residue-property plots [i](#)

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: Ricin chain A



- Molecule 2: VHH antibody



4 Data and refinement statistics i

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	38.34Å 67.11Å 68.10Å 90.00° 91.06° 90.00°	Depositor
Resolution (Å)	47.80 – 2.29 47.80 – 2.29	Depositor EDS
% Data completeness (in resolution range)	97.8 (47.80-2.29) 97.9 (47.80-2.29)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.77 (at 2.29Å)	Xtrriage
Refinement program	PHENIX 1.11.1_2575	Depositor
R, R_{free}	0.248 , 0.272 0.250 , 0.275	Depositor DCC
R_{free} test set	701 reflections (4.49%)	wwPDB-VP
Wilson B-factor (Å ²)	33.2	Xtrriage
Anisotropy	0.199	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 53.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.004 for -h,l,k 0.027 for -h,-l,-k 0.042 for h,-k,-l	Xtrriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	3173	wwPDB-VP
Average B, all atoms (Å ²)	48.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.33% 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

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	0.18	0/2075	0.39	0/2823
2	B	0.16	0/920	0.40	0/1248
All	All	0.18	0/2995	0.39	0/4071

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	2032	0	1994	45	0
2	B	902	0	862	21	0
3	A	161	0	0	10	1
3	B	78	0	0	3	1
All	All	3173	0	2856	63	1

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 11.

All (63) 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:B:29:PHE:HE2	2:B:72:ARG:HH11	1.30	0.77

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:132:ASN:ND2	3:A:302:HOH:O	2.22	0.72
1:A:64:ASN:OD1	1:A:65:HIS:N	2.28	0.67
1:A:100:ASP:N	3:A:306:HOH:O	2.24	0.67
2:B:39:GLN:HA	2:B:43:LYS:HE3	1.78	0.65
1:A:26:ARG:HD2	2:B:106:TYR:CZ	2.32	0.64
2:B:40:VAL:HG23	2:B:43:LYS:HE2	1.80	0.62
1:A:231:GLN:NE2	3:A:317:HOH:O	2.34	0.61
1:A:127:GLU:HG2	1:A:133:LEU:HA	1.85	0.59
1:A:7:PRO:HG2	1:A:31:ARG:HE	1.67	0.58
1:A:128:GLN:O	3:A:301:HOH:O	2.18	0.56
2:B:77:ASN:ND2	3:B:204:HOH:O	2.26	0.56
1:A:100:ASP:O	1:A:104:ILE:HG12	2.06	0.56
1:A:56:ARG:NH2	3:A:309:HOH:O	2.39	0.55
1:A:119:PHE:HB2	1:A:125:ARG:HG2	1.89	0.54
2:B:28:ILE:O	2:B:32:TYR:HB2	2.06	0.54
1:A:219:GLN:NE2	1:A:256:VAL:O	2.38	0.54
1:A:201:ASP:OD2	1:A:203:SER:OG	2.26	0.54
1:A:85:ARG:NH1	3:A:325:HOH:O	2.39	0.53
1:A:127:GLU:HB3	1:A:133:LEU:HG	1.91	0.53
2:B:82:ARG:NH1	3:B:212:HOH:O	2.42	0.52
1:A:5:GLN:NE2	3:A:324:HOH:O	2.38	0.52
1:A:137:ILE:HG21	1:A:169:ILE:HD11	1.91	0.52
1:A:174:MET:HE3	1:A:188:MET:HE2	1.91	0.52
2:B:40:VAL:H	2:B:43:LYS:CE	2.24	0.51
2:B:40:VAL:H	2:B:43:LYS:HE3	1.76	0.51
1:A:26:ARG:HD2	2:B:106:TYR:CE2	2.47	0.50
1:A:216:THR:O	1:A:220:GLU:HB2	2.13	0.49
1:A:22:THR:OG1	1:A:189:ARG:NE	2.44	0.49
2:B:91:THR:HG23	2:B:118:THR:HA	1.93	0.49
1:A:38:VAL:HB	2:B:32:TYR:CZ	2.48	0.49
2:B:43:LYS:HD2	2:B:44:GLU:O	2.12	0.49
1:A:62:LEU:O	1:A:69:SER:HA	2.13	0.49
1:A:29:ARG:NH2	1:A:185:GLU:OE2	2.43	0.49
1:A:48:ARG:HH22	1:A:99:GLU:HB3	1.76	0.49
1:A:234:ARG:NH1	3:A:321:HOH:O	2.36	0.48
1:A:135:GLU:OE1	1:A:135:GLU:N	2.42	0.48
2:B:4:LEU:HB3	2:B:96[B]:CYS:SG	2.55	0.47
1:A:185:GLU:O	1:A:189:ARG:HG3	2.15	0.47
1:A:130:ALA:HA	1:A:162:PRO:HA	1.96	0.47
1:A:88:ASN:HD22	1:A:88:ASN:H	1.64	0.46
1:A:143:PRO:HD3	1:A:197:ARG:HD3	1.97	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:231:GLN:NE2	3:A:307:HOH:O	2.25	0.46
2:B:29:PHE:CE1	2:B:77:ASN:HA	2.51	0.46
2:B:67:ARG:HB3	2:B:84:SER:O	2.16	0.45
1:A:48:ARG:NH1	1:A:100:ASP:OD1	2.50	0.45
2:B:40:VAL:HB	2:B:43:LYS:HG2	1.99	0.45
1:A:22:THR:O	1:A:26:ARG:HG3	2.17	0.45
1:A:108:PHE:O	1:A:114:ARG:NH1	2.50	0.45
1:A:57:PHE:CG	1:A:107:LEU:HD21	2.51	0.45
1:A:214:LEU:HD23	1:A:230:ILE:HD12	1.98	0.44
1:A:63:SER:HA	1:A:68:LEU:O	2.17	0.44
1:A:166:ARG:O	1:A:169:ILE:HG13	2.18	0.43
1:A:82:VAL:HG11	1:A:104:ILE:HD11	2.00	0.43
1:A:75:ASP:HB3	1:A:78:ASN:OD1	2.19	0.42
2:B:7:THR:HG22	2:B:21:SER:OG	2.19	0.42
2:B:89:GLU:OE2	3:B:201:HOH:O	2.21	0.42
1:A:43:PRO:HD2	1:A:253:ALA:O	2.19	0.42
2:B:5:VAL:O	2:B:22:CYS:HA	2.21	0.41
1:A:58:ILE:HG12	1:A:76:VAL:HG22	2.01	0.41
1:A:8:ILE:HG12	1:A:59:LEU:HB2	2.03	0.41
1:A:85:ARG:NH2	3:A:335:HOH:O	2.54	0.41
2:B:29:PHE:CE2	2:B:72:ARG:HD2	2.55	0.40

All (1) 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:A:374:HOH:O	3:B:202:HOH:O[1_556]	2.18	0.02

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	A	251/267 (94%)	239 (95%)	12 (5%)	0	100	100
2	B	114/129 (88%)	114 (100%)	0	0	100	100
All	All	365/396 (92%)	353 (97%)	12 (3%)	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	A	217/226 (96%)	214 (99%)	3 (1%)	59	76
2	B	94/104 (90%)	92 (98%)	2 (2%)	47	66
All	All	311/330 (94%)	306 (98%)	5 (2%)	55	73

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	48	ARG
1	A	67	GLU
1	A	88	ASN
2	B	30	SER
2	B	51	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	141	ASN
1	A	182	GLN
2	B	39	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](#)

There are no ligands in this entry.

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	257/267 (96%)	1.24	62 (24%) 2 2	18, 50, 84, 101	0
2	B	117/129 (90%)	0.63	6 (5%) 33 35	19, 39, 62, 88	1 (0%)
All	All	374/396 (94%)	1.04	68 (18%) 3 4	18, 45, 82, 101	1 (0%)

All (68) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	2	VAL	5.5
1	A	238	SER	4.5
1	A	240	PHE	4.3
1	A	126	LEU	4.1
1	A	263	PRO	3.9
1	A	225	ALA	3.5
1	A	137	ILE	3.3
1	A	133	LEU	3.3
1	A	241	SER	3.2
1	A	245	VAL	3.2
1	A	202	PRO	3.1
1	A	121	GLY	3.1
1	A	163	THR	3.0
1	A	190	THR	3.0
1	A	224	GLY	3.0
1	A	143	PRO	3.0
1	A	256	VAL	3.0
1	A	223	GLN	3.0
1	A	124	ASP	3.0
1	A	94	HIS	2.9
1	A	101	ALA	2.9
1	A	232	LEU	2.9
1	A	243	TYR	2.8
1	A	242	VAL	2.8

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Mol	Chain	Res	Type	RSRZ
1	A	228	SER	2.8
1	A	199	ALA	2.8
1	A	115	TYR	2.7
1	A	196	ARG	2.7
1	A	99	GLU	2.7
1	A	236	ASN	2.6
2	B	77	ASN	2.6
1	A	104	ILE	2.6
2	B	107	ALA	2.5
1	A	261	PRO	2.5
1	A	169	ILE	2.5
1	A	165	ALA	2.5
1	A	201	ASP	2.5
1	A	162	PRO	2.5
1	A	161	LEU	2.4
1	A	227	ALA	2.4
1	A	247	ILE	2.4
1	A	217	ALA	2.4
1	A	229	PRO	2.4
1	A	205	ILE	2.4
1	A	123	TYR	2.4
1	A	130	ALA	2.4
1	A	230	ILE	2.3
1	A	139	LEU	2.3
1	A	207	LEU	2.3
2	B	53	LEU	2.3
1	A	262	PRO	2.3
1	A	65	HIS	2.3
1	A	160	GLN	2.3
1	A	129	LEU	2.2
1	A	222	ASN	2.2
1	A	194	TYR	2.2
1	A	191	ARG	2.2
1	A	204	VAL	2.2
1	A	226	PHE	2.2
1	A	118	ALA	2.2
2	B	74	ASN	2.1
1	A	158	GLY	2.1
1	A	183	TYR	2.1
1	A	119	PHE	2.1
1	A	116	THR	2.0
2	B	103	ALA	2.0

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Mol	Chain	Res	Type	RSRZ
1	A	136	ASN	2.0
1	A	95	PRO	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](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.