



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 17, 2026 – 10:52 PM UTC

PDB ID : 9RIT / pdb_00009rit
Title : Co-crystal of broadly neutralizing biparatopic VHH in complex with cardiotoxin (P01468) *Naja pallida*
Authors : Burlet, N.J.; Laustsen, A.H.; Morth, J.P.
Deposited on : 2025-06-11
Resolution : 1.60 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

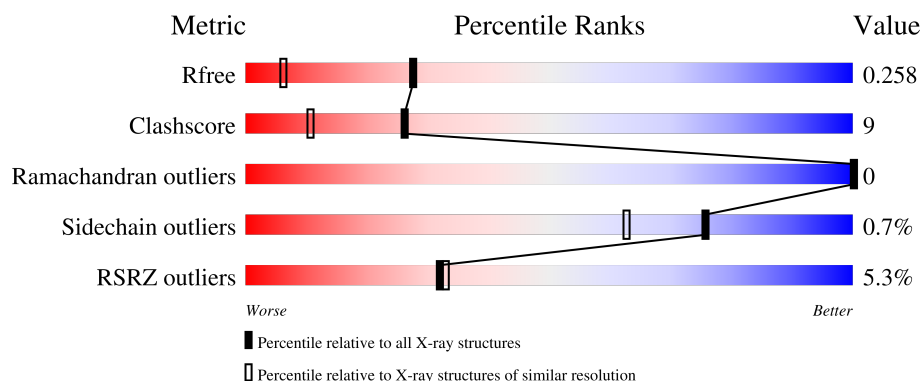
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.60 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	4673 (1.60-1.60)
Clashscore	190562	4931 (1.60-1.60)
Ramachandran outliers	187476	4831 (1.60-1.60)
Sidechain outliers	187428	4830 (1.60-1.60)
RSRZ outliers	180081	4672 (1.60-1.60)

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	125	9% 78% 16% 6%
1	B	125	5% 74% 20% 6%
2	C	60	2% 87% 13%
2	D	60	2% 83% 17%

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
3	ACT	A	202	-	-	X	-

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 3094 atoms, of which 18 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.

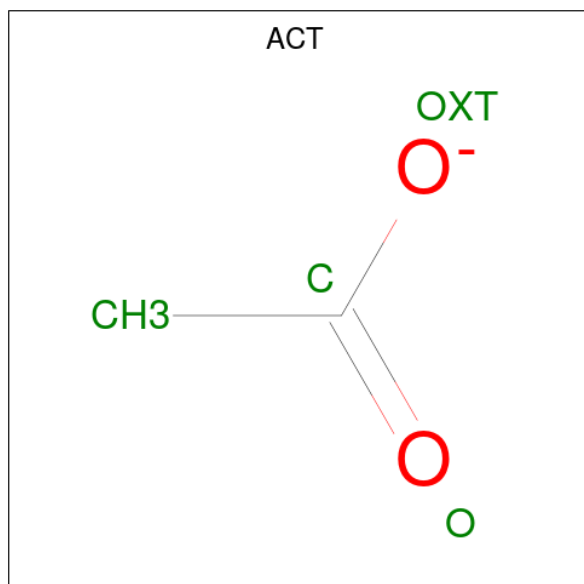
- Molecule 1 is a protein called Variable Domain of Heavy-Chain only Antibody (VHH).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	118	Total	C	N	O	S	0	1	0
			922	574	158	186	4			
1	B	118	Total	C	N	O	S	0	1	0
			917	571	155	187	4			

- Molecule 2 is a protein called Cytotoxin 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	60	Total	C	N	O	S	0	1	0
			475	302	82	79	12			
2	D	60	Total	C	N	O	S	0	0	0
			468	298	81	77	12			

- Molecule 3 is ACETATE ION (CCD ID: ACT) (formula: C₂H₃O₂).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C H O 7 2 3 2	0	0
3	A	1	Total C H O 7 2 3 2	0	0
3	B	1	Total C H O 7 2 3 2	0	0
3	B	1	Total C H O 7 2 3 2	0	0
3	B	1	Total C H O 7 2 3 2	0	0
3	D	1	Total C H O 7 2 3 2	0	0

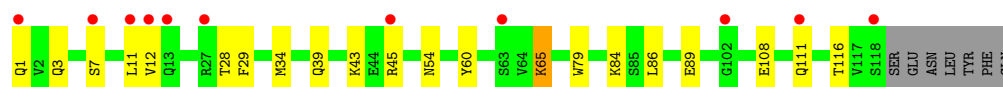
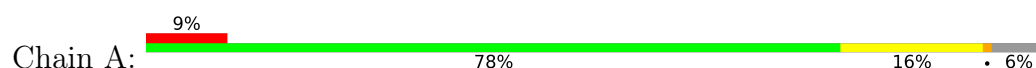
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	96	Total O 96 96	0	0
4	B	97	Total O 97 97	0	0
4	C	43	Total O 43 43	0	0
4	D	34	Total O 34 34	0	0

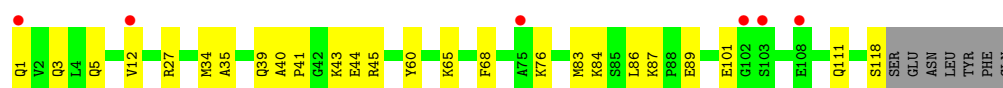
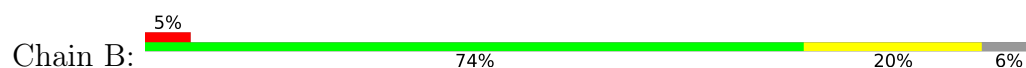
3 Residue-property plots

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.

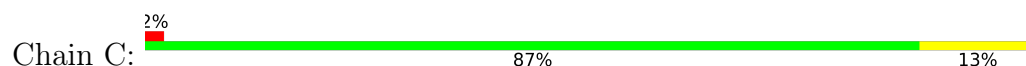
- Molecule 1: Variable Domain of Heavy-Chain only Antibody (VHH)



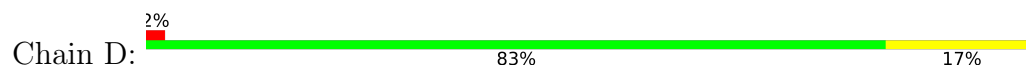
- Molecule 1: Variable Domain of Heavy-Chain only Antibody (VHH)



- Molecule 2: Cytotoxin 1



- Molecule 2: Cytotoxin 1



4 Data and refinement statistics

Property	Value	Source
Space group	P 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	41.94Å 54.91Å 143.01Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	51.26 – 1.60 51.26 – 1.60	Depositor EDS
% Data completeness (in resolution range)	95.8 (51.26-1.60) 95.9 (51.26-1.60)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.24 (at 1.60Å)	Xtrriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, R_{free}	0.222 , 0.258 0.222 , 0.258	Depositor DCC
R_{free} test set	2146 reflections (4.80%)	wwPDB-VP
Wilson B-factor (Å ²)	16.6	Xtrriage
Anisotropy	0.469	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 38.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.43$, $\langle L^2 \rangle = 0.26$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	3094	wwPDB-VP
Average B, all atoms (Å ²)	21.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 83.18 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 2.3165e-07. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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: ACT

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	0.35	0/943	0.66	1/1275 (0.1%)
1	B	0.31	0/938	0.58	0/1269
2	C	0.36	0/485	0.65	0/651
2	D	0.35	0/478	0.58	0/641
All	All	0.34	0/2844	0.62	1/3836 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	1	GLN	CB-CA-C	5.60	120.74	110.10

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	922	0	858	18	2
1	B	917	0	850	22	1
2	C	475	0	500	6	0
2	D	468	0	494	8	0
3	A	8	6	6	5	0
3	B	12	9	9	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	D	4	3	3	0	0
4	A	96	0	0	6	0
4	B	97	0	0	9	1
4	C	43	0	0	0	1
4	D	34	0	0	3	0
All	All	3076	18	2720	52	3

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 9.

All (52) 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:D:43:PRO:HG2	2:D:51:TYR:CD2	2.15	0.82
1:B:111:GLN:HG2	4:B:344:HOH:O	1.83	0.77
1:B:3:GLN:OE1	4:B:301:HOH:O	2.02	0.77
1:A:11:LEU:HD13	1:A:116:THR:HB	1.70	0.74
1:B:39:GLN:HB2	1:B:45:ARG:HG3	1.70	0.72
1:A:60:TYR:HB2	1:A:65:LYS:HG2	1.76	0.66
1:B:40:ALA:HB3	1:B:43:LYS:HD2	1.77	0.66
1:A:3:GLN:OE1	4:A:301:HOH:O	2.13	0.66
1:B:101:GLU:OE1	4:B:302:HOH:O	2.14	0.65
1:B:60:TYR:HB2	1:B:65:LYS:HG3	1.81	0.62
1:B:68:PHE:CE1	1:B:83:MET:HB3	2.34	0.62
1:A:111:GLN:OE1	4:A:302:HOH:O	2.16	0.61
1:A:39:GLN:HB2	1:A:45[A]:ARG:HG2	1.83	0.60
1:A:29:PHE:H	3:A:202:ACT:H1	1.68	0.59
1:B:39:GLN:HB2	1:B:45:ARG:CG	2.33	0.58
2:D:22:TYR:OH	2:D:35:LYS:HE2	2.05	0.56
1:B:5:GLN:NE2	4:B:306:HOH:O	2.39	0.56
2:D:28:ALA:N	4:D:202:HOH:O	2.33	0.56
1:A:43:LYS:HD3	4:B:320:HOH:O	2.05	0.55
1:B:27:ARG:HD3	2:C:28:ALA:O	2.07	0.55
2:D:44:LYS:HE2	4:D:227:HOH:O	2.06	0.55
1:B:84:LYS:HE2	4:B:375:HOH:O	2.07	0.54
1:A:65:LYS:HG3	4:A:343:HOH:O	2.08	0.53
2:D:50:LYS:HE3	2:D:51:TYR:O	2.09	0.53
2:D:43:PRO:HG2	2:D:51:TYR:CE2	2.44	0.52
1:A:54:ASN:OD1	1:A:54:ASN:C	2.53	0.51
2:C:24:MET:HB2	2:C:51:TYR:CD1	2.46	0.49
1:A:12:VAL:HG11	1:A:86:LEU:HD13	1.95	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:108:GLU:OE1	4:A:303:HOH:O	2.20	0.48
1:A:89:GLU:OE2	1:B:76:LYS:NZ	2.39	0.48
1:A:28:THR:HA	3:A:202:ACT:H2	1.95	0.48
1:A:65:LYS:HE2	4:A:364:HOH:O	2.13	0.48
2:C:24:MET:HB2	2:C:51:TYR:CE1	2.50	0.46
2:C:27:ARG:O	2:C:30:PRO:HD3	2.16	0.46
3:A:201:ACT:H2	2:C:8:PRO:CG	2.47	0.44
1:A:111:GLN:HG2	4:A:311:HOH:O	2.17	0.44
1:A:28:THR:HA	3:A:202:ACT:CH3	2.46	0.44
1:B:111:GLN:NE2	1:B:111:GLN:H	2.16	0.43
1:B:44:GLU:HG3	4:B:337:HOH:O	2.18	0.43
1:B:40:ALA:HB1	1:B:41:PRO:HD2	2.02	0.42
1:B:34:MET:HG3	1:B:35:ALA:N	2.34	0.42
1:B:12:VAL:HG11	1:B:86:LEU:HD13	2.01	0.41
2:D:5:GLN:HE21	2:D:11:TRP:N	2.19	0.41
1:B:87:LYS:HD2	1:B:89:GLU:OE2	2.21	0.41
1:B:5:GLN:CD	4:B:306:HOH:O	2.63	0.41
1:B:34:MET:HE2	1:B:34:MET:HB2	1.80	0.41
1:B:39:GLN:OE1	1:B:45:ARG:HG3	2.20	0.41
1:B:111:GLN:NE2	4:B:312:HOH:O	2.52	0.41
2:C:22:TYR:HA	2:C:52:MET:O	2.21	0.41
2:D:48:LEU:HD23	4:D:205:HOH:O	2.20	0.41
1:A:29:PHE:H	3:A:202:ACT:CH3	2.32	0.40
1:A:34:MET:HG2	1:A:79:TRP:CD2	2.57	0.40

All (3) 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)
1:A:7:SER:OG	1:A:7:SER:OG[4_555]	1.69	0.51
1:A:84:LYS:NZ	1:B:1:GLN:OE1[1_455]	1.95	0.25
4:B:386:HOH:O	4:C:108:HOH:O[1_545]	2.17	0.03

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	117/125 (94%)	116 (99%)	1 (1%)	0	100	100
1	B	117/125 (94%)	116 (99%)	1 (1%)	0	100	100
2	C	59/60 (98%)	56 (95%)	3 (5%)	0	100	100
2	D	58/60 (97%)	56 (97%)	2 (3%)	0	100	100
All	All	351/370 (95%)	344 (98%)	7 (2%)	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	95/101 (94%)	94 (99%)	1 (1%)	65	46
1	B	95/101 (94%)	94 (99%)	1 (1%)	65	46
2	C	57/56 (102%)	57 (100%)	0	100	100
2	D	56/56 (100%)	56 (100%)	0	100	100
All	All	303/314 (96%)	301 (99%)	2 (1%)	76	63

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

Mol	Chain	Res	Type
1	A	65	LYS
1	B	118	SER

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

Mol	Chain	Res	Type
1	B	3	GLN
1	B	13	GLN
1	B	77	ASN

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Mol	Chain	Res	Type
1	B	111	GLN
1	B	114	GLN
2	D	5	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

6 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	$\# Z > 2$
3	ACT	B	202	-	3,3,3	1.04	0	3,3,3	1.64	0
3	ACT	A	201	-	3,3,3	0.90	0	3,3,3	1.58	0
3	ACT	B	201	-	3,3,3	0.99	0	3,3,3	1.44	1 (33%)
3	ACT	D	101	-	3,3,3	1.33	0	3,3,3	1.38	0
3	ACT	B	203	-	3,3,3	1.00	0	3,3,3	1.58	0
3	ACT	A	202	-	3,3,3	0.89	0	3,3,3	1.63	1 (33%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
3	A	202	ACT	OXT-C-O	2.14	129.97	122.03
3	B	201	ACT	OXT-C-O	2.07	129.71	122.03

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	201	ACT	1	0
3	A	202	ACT	4	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 ⓘ

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	118/125 (94%)	0.69	11 (9%) 14 14	10, 18, 31, 45	1 (0%)
1	B	118/125 (94%)	0.71	6 (5%) 33 34	7, 19, 30, 40	1 (0%)
2	C	60/60 (100%)	0.45	1 (1%) 69 72	10, 18, 28, 39	1 (1%)
2	D	60/60 (100%)	0.65	1 (1%) 69 72	15, 22, 37, 42	0
All	All	356/370 (96%)	0.65	19 (5%) 32 33	7, 19, 31, 45	3 (0%)

All (19) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1	GLN	6.3
1	B	102	GLY	4.4
1	B	103	SER	3.2
1	A	45[A]	ARG	3.1
1	B	1	GLN	2.7
1	A	13	GLN	2.6
1	A	118	SER	2.5
1	A	11	LEU	2.5
1	A	102	GLY	2.5
1	A	111	GLN	2.4
1	A	63	SER	2.4
1	B	75	ALA	2.2
1	A	27	ARG	2.1
1	A	7	SER	2.1
1	B	12	VAL	2.1
1	B	108	GLU	2.0
1	A	12	VAL	2.0
2	D	41	VAL	2.0
2	C	41	VAL	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
3	ACT	A	201	4/4	0.73	0.14	33,39,44,50	0
3	ACT	B	203	4/4	0.75	0.12	43,45,51,51	0
3	ACT	B	202	4/4	0.80	0.13	26,31,37,42	0
3	ACT	A	202	4/4	0.86	0.14	21,25,28,30	0
3	ACT	D	101	4/4	0.86	0.12	19,23,30,32	0
3	ACT	B	201	4/4	0.91	0.12	17,20,23,24	0

6.5 Other polymers [i](#)

There are no such residues in this entry.