



# wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 11, 2023 – 04:43 AM EDT

PDB ID : 7N0I  
Title : Structure of the SARS-CoV-2 N protein C-terminal domain bound to single-domain antibody E2  
Authors : Ye, Q.; Corbett, K.D.  
Deposited on : 2021-05-25  
Resolution : 2.20 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 : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.35.1  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.35.1

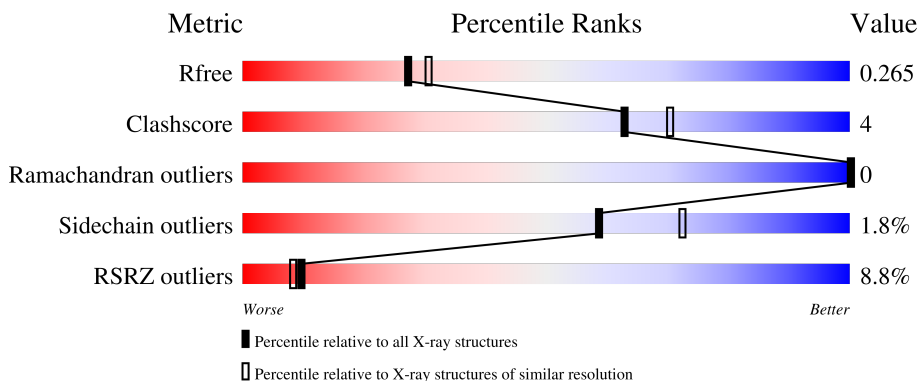
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.20 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))
$R_{free}$	130704	4898 (2.20-2.20)
Clashscore	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (2.20-2.20)
RSRZ outliers	127900	4800 (2.20-2.20)

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	A	96	 5% 91% 9%
1	B	96	 3% 95% 5%
1	C	96	 5% 93% 7%
1	D	96	 2% 91% 8%
1	E	96	 4% 86% 12%

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Mol	Chain	Length	Quality of chain
1	F	96	
1	G	96	
1	H	96	
2	I	139	
2	J	139	
2	K	139	
2	L	139	

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	D	401	-	-	X	-

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 11100 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 Nucleoprotein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	96	765	487	132	144	2	0	0	0
1	B	96	765	487	132	144	2	0	0	0
1	C	96	765	487	132	144	2	0	0	0
1	D	96	765	487	132	144	2	0	0	0
1	E	96	765	487	132	144	2	0	0	0
1	F	96	765	487	132	144	2	0	0	0
1	H	96	765	487	132	144	2	0	0	0
1	G	96	765	487	132	144	2	0	0	0

- Molecule 2 is a protein called Single-domain antibody E2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	I	136	1048	650	189	205	4	0	0	0
2	J	135	1048	650	190	204	4	0	0	0
2	K	130	1004	623	179	197	5	0	0	0
2	L	131	1009	626	180	198	5	0	0	0

- Molecule 3 is ACETATE ION (three-letter code: ACT) (formula: C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	D	1	Total C O 4 2 2	0	0
3	G	1	Total C O 4 2 2	0	0

- Molecule 4 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	D	1	Total Mg 1 1	0	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	51	Total O 51 51	0	0
5	B	80	Total O 80 80	0	0
5	C	87	Total O 87 87	0	0
5	D	80	Total O 80 80	0	0
5	E	26	Total O 26 26	0	0
5	F	21	Total O 21 21	0	0

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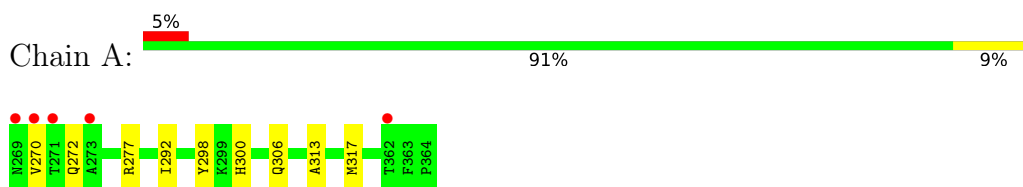
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<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>		<b>ZeroOcc</b>	<b>AltConf</b>
5	H	17	Total 17	O 17	0	0
5	I	97	Total 97	O 97	0	0
5	J	125	Total 125	O 125	0	0
5	K	123	Total 123	O 123	0	0
5	L	135	Total 135	O 135	0	0
5	G	20	Total 20	O 20	0	0

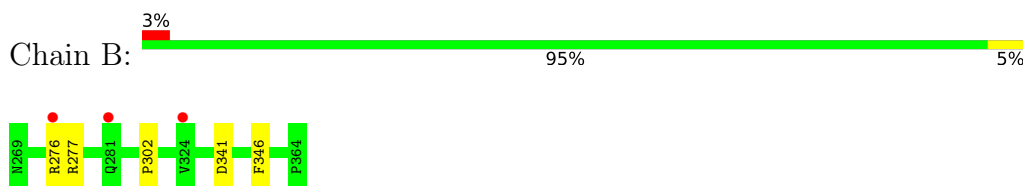
### 3 Residue-property plots [i](#)

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 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.

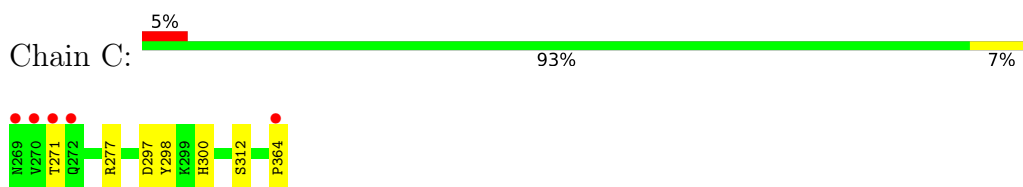
- Molecule 1: Nucleoprotein



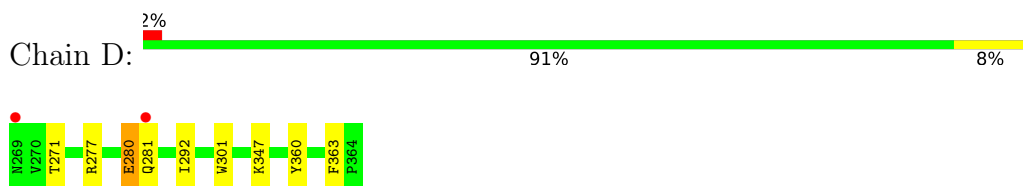
- Molecule 1: Nucleoprotein



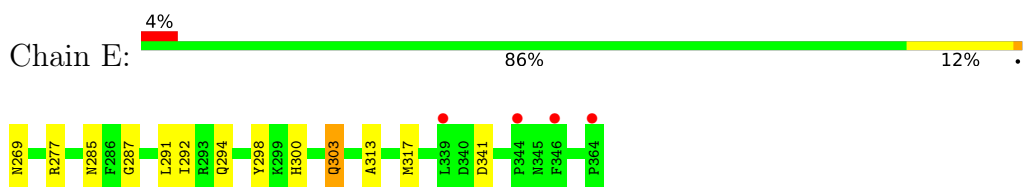
- Molecule 1: Nucleoprotein



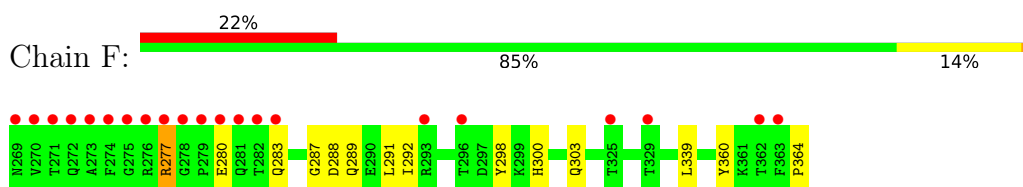
- Molecule 1: Nucleoprotein



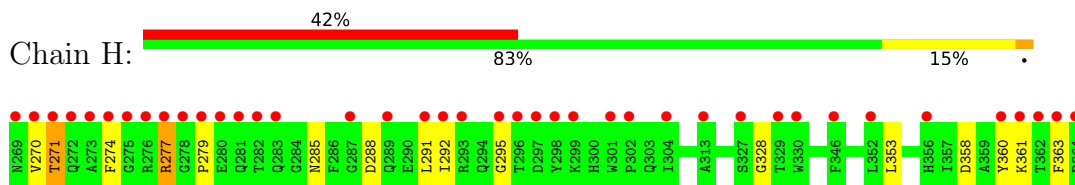
- Molecule 1: Nucleoprotein



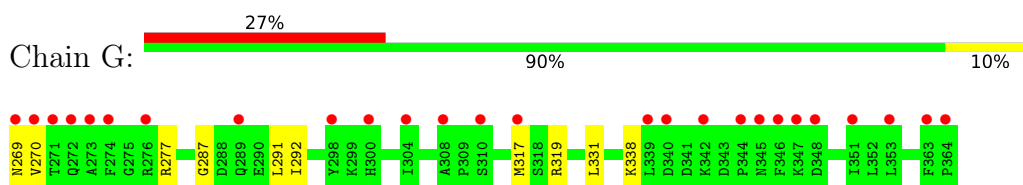
- Molecule 1: Nucleoprotein



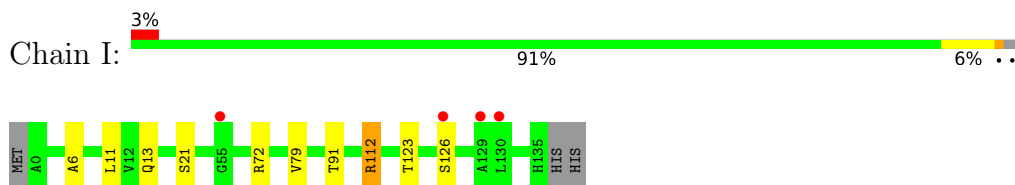
- Molecule 1: Nucleoprotein



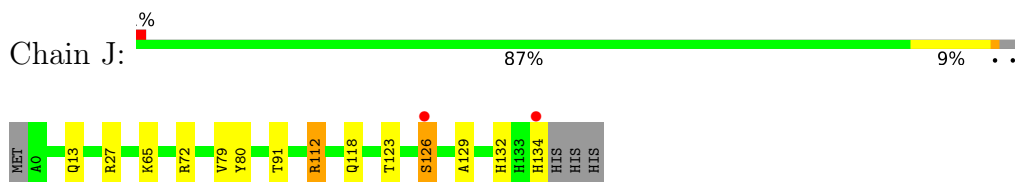
- Molecule 1: Nucleoprotein



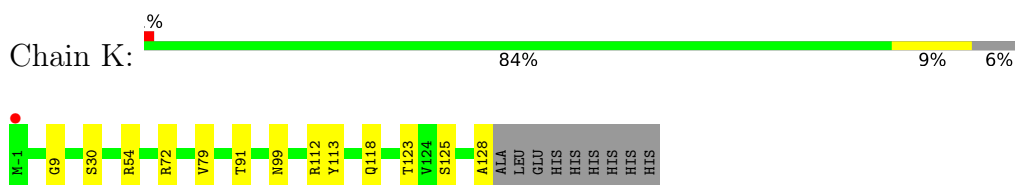
- Molecule 2: Single-domain antibody E2



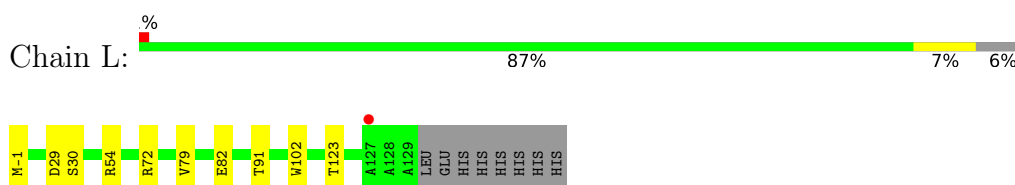
- Molecule 2: Single-domain antibody E2



- Molecule 2: Single-domain antibody E2



- Molecule 2: Single-domain antibody E2





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	75.85Å 131.56Å 140.05Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.69 – 2.20 49.69 – 1.80	Depositor EDS
% Data completeness (in resolution range)	89.1 (49.69-2.20) 99.7 (49.69-1.80)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.50 (at 1.79Å)	Xtrriage
Refinement program	PHENIX 1.19.1_4122	Depositor
R, $R_{free}$	0.239 , 0.271 0.236 , 0.265	Depositor DCC
$R_{free}$ test set	6589 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	33.0	Xtrriage
Anisotropy	0.496	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.30 , 40.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.35$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	11100	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	51.0	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 44.16 % 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 1.5895e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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: ACT, MG

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	0.26	0/786	0.50	0/1063
1	B	0.26	0/786	0.50	0/1063
1	C	0.27	0/786	0.49	0/1063
1	D	0.28	0/786	0.51	0/1063
1	E	0.30	0/786	0.49	0/1063
1	F	0.28	0/786	0.49	0/1063
1	G	0.28	0/786	0.52	0/1063
1	H	0.28	0/786	0.51	0/1063
2	I	0.25	0/1073	0.53	0/1458
2	J	0.26	0/1074	0.55	0/1459
2	K	0.27	0/1027	0.57	0/1394
2	L	0.26	0/1032	0.56	0/1401
All	All	0.27	0/10494	0.52	0/14216

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	765	0	733	5	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	765	0	733	3	0
1	C	765	0	733	4	0
1	D	765	0	733	5	0
1	E	765	0	733	11	0
1	F	765	0	733	9	0
1	G	765	0	733	7	0
1	H	765	0	733	16	0
2	I	1048	0	984	7	0
2	J	1048	0	987	10	0
2	K	1004	0	953	9	0
2	L	1009	0	958	7	0
3	D	4	0	3	2	0
3	G	4	0	3	0	0
4	D	1	0	0	0	0
5	A	51	0	0	1	0
5	B	80	0	0	0	0
5	C	87	0	0	2	0
5	D	80	0	0	3	0
5	E	26	0	0	2	0
5	F	21	0	0	1	0
5	G	20	0	0	0	0
5	H	17	0	0	0	0
5	I	97	0	0	2	0
5	J	125	0	0	2	0
5	K	123	0	0	2	0
5	L	135	0	0	3	0
All	All	11100	0	9752	86	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.

The worst 5 of 86 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:270:VAL:HG21	1:H:295:GLY:HA3	1.64	0.79
1:H:358:ASP:HB3	1:H:361:LYS:HE3	1.68	0.75
1:H:328:GLY:HA3	1:G:338:LYS:HE3	1.70	0.74
1:B:276:ARG:HH22	1:D:347:LYS:H	1.40	0.70
1:E:341:ASP:OD2	5:E:401:HOH:O	2.10	0.69

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	A	94/96 (98%)	94 (100%)	0	0	100	100
1	B	94/96 (98%)	94 (100%)	0	0	100	100
1	C	94/96 (98%)	94 (100%)	0	0	100	100
1	D	94/96 (98%)	94 (100%)	0	0	100	100
1	E	94/96 (98%)	94 (100%)	0	0	100	100
1	F	94/96 (98%)	94 (100%)	0	0	100	100
1	G	94/96 (98%)	94 (100%)	0	0	100	100
1	H	94/96 (98%)	93 (99%)	1 (1%)	0	100	100
2	I	134/139 (96%)	133 (99%)	1 (1%)	0	100	100
2	J	133/139 (96%)	132 (99%)	1 (1%)	0	100	100
2	K	128/139 (92%)	127 (99%)	1 (1%)	0	100	100
2	L	129/139 (93%)	128 (99%)	1 (1%)	0	100	100
All	All	1276/1324 (96%)	1271 (100%)	5 (0%)	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	80/80 (100%)	79 (99%)	1 (1%)	69	81
1	B	80/80 (100%)	79 (99%)	1 (1%)	69	81

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	C	80/80 (100%)	78 (98%)	2 (2%)	47	60
1	D	80/80 (100%)	77 (96%)	3 (4%)	33	42
1	E	80/80 (100%)	78 (98%)	2 (2%)	47	60
1	F	80/80 (100%)	79 (99%)	1 (1%)	69	81
1	G	80/80 (100%)	79 (99%)	1 (1%)	69	81
1	H	80/80 (100%)	78 (98%)	2 (2%)	47	60
2	I	107/112 (96%)	106 (99%)	1 (1%)	78	88
2	J	108/112 (96%)	104 (96%)	4 (4%)	34	43
2	K	104/112 (93%)	104 (100%)	0	100	100
2	L	104/112 (93%)	103 (99%)	1 (1%)	76	86
All	All	1063/1088 (98%)	1044 (98%)	19 (2%)	59	72

5 of 19 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	J	118	GLN
2	L	-1	MET
1	G	277	ARG
2	J	134	HIS
1	E	303	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 33 such sidechains are listed below:

Mol	Chain	Res	Type
2	L	33	HIS
2	L	77	ASN
1	G	349	GLN
1	F	272	GLN
1	E	294	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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 3 ligands modelled in this entry, 1 is monoatomic - leaving 2 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	ACT	G	401	-	3,3,3	1.29	0	3,3,3	1.49	0
3	ACT	D	401	-	3,3,3	1.03	0	3,3,3	1.39	0

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	D	401	ACT	2	0

## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues

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	A	96/96 (100%)	0.07	5 (5%) 27 26	21, 54, 83, 110	0
1	B	96/96 (100%)	-0.15	3 (3%) 49 47	19, 35, 78, 104	0
1	C	96/96 (100%)	0.08	5 (5%) 27 26	15, 32, 75, 108	0
1	D	96/96 (100%)	0.12	2 (2%) 63 61	13, 31, 78, 105	0
1	E	96/96 (100%)	0.19	4 (4%) 36 34	29, 63, 100, 113	0
1	F	96/96 (100%)	1.43	21 (21%) 0 0	29, 67, 124, 144	0
1	G	96/96 (100%)	1.36	26 (27%) 0 0	40, 88, 126, 145	0
1	H	96/96 (100%)	3.66	40 (41%) 0 0	46, 103, 161, 172	0
2	I	136/139 (97%)	-0.11	4 (2%) 51 49	27, 40, 92, 107	0
2	J	135/139 (97%)	-0.22	2 (1%) 73 72	15, 27, 74, 98	0
2	K	130/139 (93%)	-0.26	1 (0%) 86 85	15, 28, 72, 106	0
2	L	131/139 (94%)	-0.06	1 (0%) 86 85	13, 27, 63, 98	0
All	All	1300/1324 (98%)	0.43	114 (8%) 10 8	13, 42, 111, 172	0

The worst 5 of 114 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	H	280	GLU	20.4
1	H	270	VAL	19.5
1	H	271	THR	18.7
1	H	281	GLN	17.0
1	H	363	PHE	16.9

### 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 monosaccharides 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(Å <sup>2</sup> )	Q<0.9
4	MG	D	402	1/1	0.88	0.09	31,31,31,31	0
3	ACT	G	401	4/4	0.90	0.17	67,69,70,72	0
3	ACT	D	401	4/4	0.93	0.29	39,39,40,51	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.