



# wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 25, 2021 – 06:04 PM EDT

PDB ID : 7RBS  
Title : The crystal structure of Papain-Like Protease of SARS CoV-2, C111S mutant, in complex with human ISG15  
Authors : Osipiuk, J.; Tesar, C.; Jedrzejczak, R.; Endres, M.; Wydorski, P.; Joachimiak, L.; Joachimiak, A.; Center for Structural Genomics of Infectious Diseases (CS-GID)  
Deposited on : 2021-07-06  
Resolution : 2.98 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.

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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
Xtriage (Phenix)	:	1.13
EDS	:	2.23.2
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)	:	2.23.2

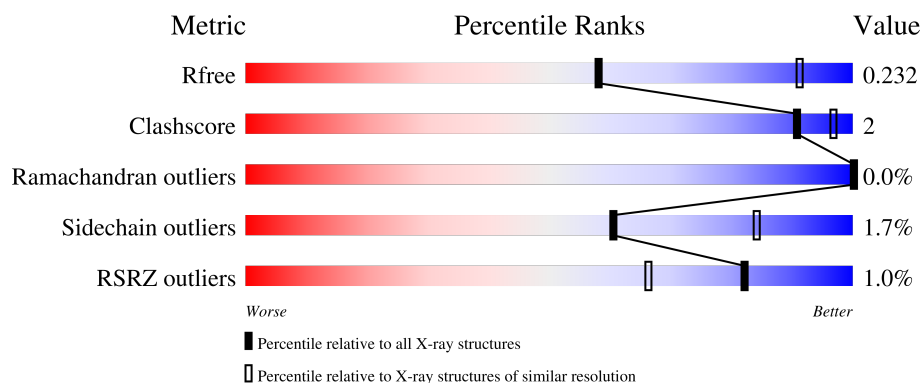
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

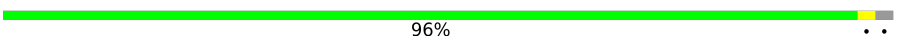

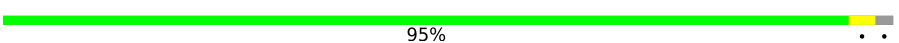

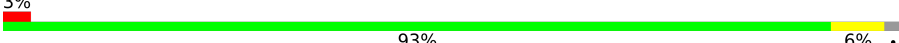
The reported resolution of this entry is 2.98 Å.

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	2754 (3.00-2.96)
Clashscore	141614	3103 (3.00-2.96)
Ramachandran outliers	138981	2993 (3.00-2.96)
Sidechain outliers	138945	2996 (3.00-2.96)
RSRZ outliers	127900	2644 (3.00-2.96)

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	318	 96% ..
1	C	318	 % 91% 7% ..
1	E	318	 95% ..
1	G	318	 92% 7% .
1	I	318	 3% 93% 6% .

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Mol	Chain	Length	Quality of chain
2	B	159	<div><div><div>%</div><div></div><div>91%</div><div>7% ..</div></div></div>
2	D	159	<div><div><div>%</div><div></div><div>93%</div><div>6% .</div></div></div>
2	F	159	<div><div><div></div><div></div><div>92%</div><div>7% .</div></div></div>
2	H	159	<div><div><div>3%</div><div></div><div>89%</div><div>9% ..</div></div></div>
2	J	159	<div><div><div>%</div><div></div><div>94%</div><div>5% .</div></div></div>

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 18482 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 Papain-like protease.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	312	Total	C	N	O	S	0	1	0
			2481	1579	410	474	18			
1	C	313	Total	C	N	O	S	0	0	0
			2483	1581	410	474	18			
1	E	313	Total	C	N	O	S	0	0	0
			2483	1581	410	474	18			
1	G	313	Total	C	N	O	S	0	0	0
			2483	1581	410	474	18			
1	I	313	Total	C	N	O	S	0	0	0
			2483	1581	410	474	18			

There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	SER	-	expression tag	UNP P0DTC1
A	-1	ASN	-	expression tag	UNP P0DTC1
A	0	ALA	-	expression tag	UNP P0DTC1
A	111	SER	CYS	engineered mutation	UNP P0DTC1
C	-2	SER	-	expression tag	UNP P0DTC1
C	-1	ASN	-	expression tag	UNP P0DTC1
C	0	ALA	-	expression tag	UNP P0DTC1
C	111	SER	CYS	engineered mutation	UNP P0DTC1
E	-2	SER	-	expression tag	UNP P0DTC1
E	-1	ASN	-	expression tag	UNP P0DTC1
E	0	ALA	-	expression tag	UNP P0DTC1
E	111	SER	CYS	engineered mutation	UNP P0DTC1
G	-2	SER	-	expression tag	UNP P0DTC1
G	-1	ASN	-	expression tag	UNP P0DTC1
G	0	ALA	-	expression tag	UNP P0DTC1
G	111	SER	CYS	engineered mutation	UNP P0DTC1
I	-2	SER	-	expression tag	UNP P0DTC1
I	-1	ASN	-	expression tag	UNP P0DTC1
I	0	ALA	-	expression tag	UNP P0DTC1

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Chain	Residue	Modelled	Actual	Comment	Reference
I	111	SER	CYS	engineered mutation	UNP P0DTC1

- Molecule 2 is a protein called Ubiquitin-like protein ISG15.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	157	Total 1202	C 760	N 210	O 228	S 4	0	0	0
2	D	157	Total 1202	C 760	N 210	O 228	S 4	0	0	0
2	F	157	Total 1202	C 760	N 210	O 228	S 4	0	0	0
2	H	157	Total 1202	C 760	N 210	O 228	S 4	0	0	0
2	J	157	Total 1202	C 760	N 210	O 228	S 4	0	0	0

There are 15 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	-1	SER	-	expression tag	UNP P05161
B	0	ASN	-	expression tag	UNP P05161
B	1	ALA	-	expression tag	UNP P05161
D	-1	SER	-	expression tag	UNP P05161
D	0	ASN	-	expression tag	UNP P05161
D	1	ALA	-	expression tag	UNP P05161
F	-1	SER	-	expression tag	UNP P05161
F	0	ASN	-	expression tag	UNP P05161
F	1	ALA	-	expression tag	UNP P05161
H	-1	SER	-	expression tag	UNP P05161
H	0	ASN	-	expression tag	UNP P05161
H	1	ALA	-	expression tag	UNP P05161
J	-1	SER	-	expression tag	UNP P05161
J	0	ASN	-	expression tag	UNP P05161
J	1	ALA	-	expression tag	UNP P05161

- Molecule 3 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Zn	0	0
			1	1		
3	C	1	Total	Zn	0	0
			1	1		

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	E	1	Total 1	Zn 1	0	0
3	G	1	Total 1	Zn 1	0	0
3	I	1	Total 1	Zn 1	0	0

- Molecule 4 is water.

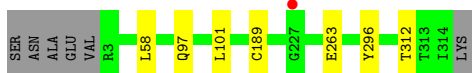
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	12	Total 12	O 12	0	0
4	B	3	Total 3	O 3	0	0
4	C	12	Total 12	O 12	0	0
4	D	3	Total 3	O 3	0	0
4	E	7	Total 7	O 7	0	0
4	F	1	Total 1	O 1	0	0
4	G	11	Total 11	O 11	0	0
4	H	2	Total 2	O 2	0	0
4	I	2	Total 2	O 2	0	0
4	J	1	Total 1	O 1	0	0

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

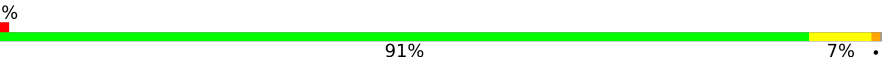
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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: Papain-like protease

Chain A:  96% ..



- Molecule 1: Papain-like protease

Chain C:  91% 7% ..



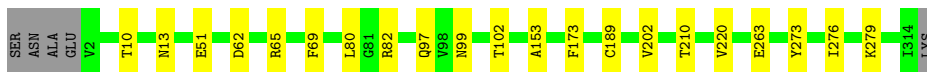
- Molecule 1: Papain-like protease

Chain E:  95% ..




- Molecule 1: Papain-like protease

Chain G:  92% 7% .

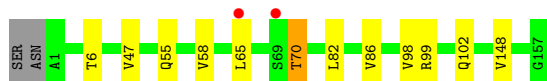
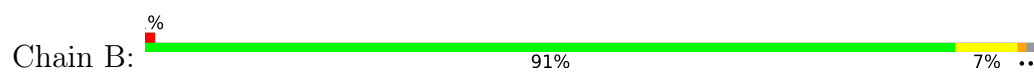


- Molecule 1: Papain-like protease

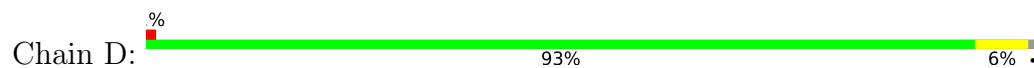
Chain I:  93% 6% .



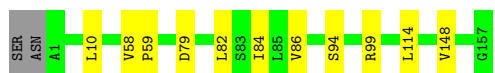
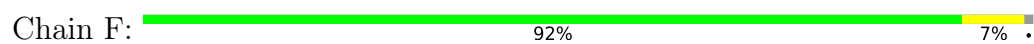
- Molecule 2: Ubiquitin-like protein ISG15



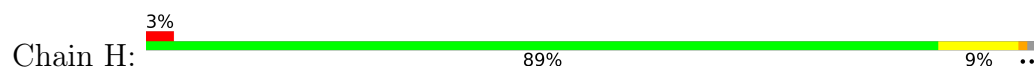
- Molecule 2: Ubiquitin-like protein ISG15



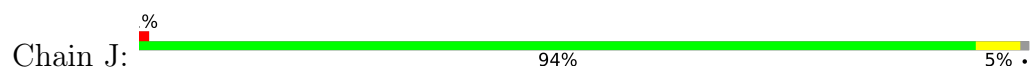
- Molecule 2: Ubiquitin-like protein ISG15



- Molecule 2: Ubiquitin-like protein ISG15



- Molecule 2: Ubiquitin-like protein ISG15



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	153.67Å 220.87Å 232.79Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.99 – 2.98 48.94 – 2.98	Depositor EDS
% Data completeness (in resolution range)	97.2 (48.99-2.98) 97.2 (48.94-2.98)	Depositor EDS
$R_{merge}$	0.21	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.90 (at 3.01Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, $R_{free}$	0.195 , 0.236 0.195 , 0.232	Depositor DCC
$R_{free}$ test set	3786 reflections (4.84%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	69.1	Xtriage
Anisotropy	0.389	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.29 , 28.1	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	18482	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	81.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.15% 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

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: ZN

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	0.63	0/2543	0.75	0/3451
1	C	0.64	0/2542	0.74	0/3450
1	E	0.64	0/2542	0.75	0/3450
1	G	0.64	0/2542	0.74	0/3450
1	I	0.64	0/2542	0.73	0/3450
2	B	0.67	0/1222	0.76	0/1653
2	D	0.67	0/1222	0.74	0/1653
2	F	0.66	0/1222	0.76	0/1653
2	H	0.66	0/1222	0.75	0/1653
2	J	0.67	0/1222	0.76	0/1653
All	All	0.65	0/18821	0.75	0/25516

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

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	2481	0	2422	2	0
1	C	2483	0	2425	12	0
1	E	2483	0	2425	4	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	G	2483	0	2425	10	0
1	I	2483	0	2425	8	0
2	B	1202	0	1230	8	0
2	D	1202	0	1230	3	0
2	F	1202	0	1230	6	0
2	H	1202	0	1230	7	0
2	J	1202	0	1230	4	0
3	A	1	0	0	0	0
3	C	1	0	0	0	0
3	E	1	0	0	0	0
3	G	1	0	0	0	0
3	I	1	0	0	0	0
4	A	12	0	0	0	0
4	B	3	0	0	0	0
4	C	12	0	0	0	0
4	D	3	0	0	0	0
4	E	7	0	0	0	0
4	F	1	0	0	0	0
4	G	11	0	0	0	0
4	H	2	0	0	0	0
4	I	2	0	0	0	0
4	J	1	0	0	0	0
All	All	18482	0	18272	63	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 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)
1:A:263:GLU:OE1	1:A:296:TYR:OH	2.16	0.60
2:B:6:THR:HB	2:B:70:THR:HG23	1.86	0.58
1:E:82:ARG:NH2	1:E:153:ALA:O	2.37	0.57
2:B:47:VAL:HG22	2:B:65:LEU:HD21	1.87	0.57
1:C:98:VAL:HG12	1:C:98:VAL:O	2.05	0.56

There are no symmetry-related clashes.

## 5.3 Torsion angles

### 5.3.1 Protein backbone

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	311/318 (98%)	290 (93%)	21 (7%)	0	100	100
1	C	311/318 (98%)	291 (94%)	19 (6%)	1 (0%)	41	74
1	E	311/318 (98%)	290 (93%)	21 (7%)	0	100	100
1	G	311/318 (98%)	288 (93%)	23 (7%)	0	100	100
1	I	311/318 (98%)	291 (94%)	20 (6%)	0	100	100
2	B	155/159 (98%)	152 (98%)	3 (2%)	0	100	100
2	D	155/159 (98%)	147 (95%)	8 (5%)	0	100	100
2	F	155/159 (98%)	151 (97%)	4 (3%)	0	100	100
2	H	155/159 (98%)	148 (96%)	7 (4%)	0	100	100
2	J	155/159 (98%)	151 (97%)	4 (3%)	0	100	100
All	All	2330/2385 (98%)	2199 (94%)	130 (6%)	1 (0%)	100	100

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	98	VAL

### 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	273/277 (99%)	270 (99%)	3 (1%)	73	90
1	C	273/277 (99%)	267 (98%)	6 (2%)	52	80

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	E	273/277 (99%)	269 (98%)	4 (2%)	65	86
1	G	273/277 (99%)	270 (99%)	3 (1%)	73	90
1	I	273/277 (99%)	269 (98%)	4 (2%)	65	86
2	B	134/136 (98%)	133 (99%)	1 (1%)	84	93
2	D	134/136 (98%)	129 (96%)	5 (4%)	34	68
2	F	134/136 (98%)	133 (99%)	1 (1%)	84	93
2	H	134/136 (98%)	127 (95%)	7 (5%)	23	57
2	J	134/136 (98%)	134 (100%)	0	100	100
All	All	2035/2065 (98%)	2001 (98%)	34 (2%)	60	84

5 of 34 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	H	108	LYS
2	H	139	GLU
1	I	137	TYR
2	D	50	SER
2	D	35	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 11 such sidechains are listed below:

Mol	Chain	Res	Type
1	G	236	GLN
2	H	16	GLN
2	J	16	GLN
1	I	146	ASN
1	E	156	ASN

### 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 [i](#)

There are no monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 5 ligands modelled in this entry, 5 are monoatomic - leaving 0 for Mogul analysis.

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.

No monomer is involved in short contacts.

## 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	A	312/318 (98%)	-0.01	1 (0%) 94 87	54, 69, 98, 148	0
1	C	313/318 (98%)	0.00	2 (0%) 89 77	58, 76, 103, 137	0
1	E	313/318 (98%)	-0.02	1 (0%) 94 87	60, 74, 102, 144	0
1	G	313/318 (98%)	-0.07	0 100 100	56, 73, 98, 146	0
1	I	313/318 (98%)	0.18	9 (2%) 51 32	64, 79, 111, 142	0
2	B	157/159 (98%)	0.14	2 (1%) 77 59	67, 86, 108, 121	0
2	D	157/159 (98%)	0.07	2 (1%) 77 59	64, 89, 115, 125	0
2	F	157/159 (98%)	0.26	0 100 100	69, 91, 113, 136	0
2	H	157/159 (98%)	0.35	5 (3%) 47 29	66, 89, 113, 144	0
2	J	157/159 (98%)	0.27	2 (1%) 77 59	68, 91, 114, 137	0
All	All	2349/2385 (98%)	0.08	24 (1%) 82 66	54, 80, 111, 148	0

The worst 5 of 24 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	225	THR	3.2
2	H	12	GLY	3.1
2	B	65	LEU	3.1
1	I	314	ILE	2.8
1	I	268	TYR	2.7

### 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( $\text{\AA}^2$ )	Q<0.9
3	ZN	E	501	1/1	0.60	0.12	147,147,147,147	1
3	ZN	C	501	1/1	0.81	0.10	136,136,136,136	1
3	ZN	G	501	1/1	0.89	0.04	144,144,144,144	1
3	ZN	I	501	1/1	0.91	0.07	140,140,140,140	1
3	ZN	A	501	1/1	0.93	0.08	145,145,145,145	1

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

There are no such residues in this entry.