



# wwPDB X-ray Structure Validation Summary Report ⓘ

Jan 15, 2020 – 06:49 PM EST

PDB ID : 3C01  
Title : Crystal structural of native SpaS C-terminal domain  
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Deposited on : 2008-01-18  
Resolution : 2.60 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  
Mogul : 1.8.0 (224370), CSD as540be (2019)  
Xtriage (Phenix) : 1.13  
EDS : 2.4  
Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)  
Refmac : 5.8.0158  
CCP4 : 7.0 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.4

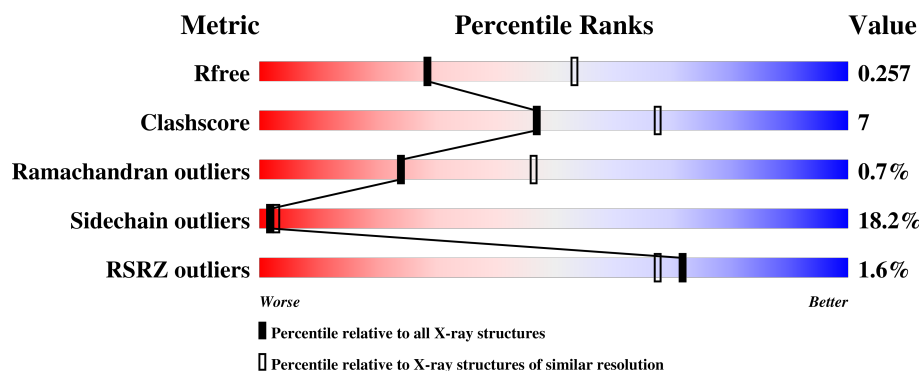
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.60 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))
$R_{free}$	111664	2767 (2.60-2.60)
Clashscore	122126	3110 (2.60-2.60)
Ramachandran outliers	120053	3062 (2.60-2.60)
Sidechain outliers	120020	3062 (2.60-2.60)
RSRZ outliers	108989	2706 (2.60-2.60)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	48	
1	B	48	
1	C	48	
1	D	48	
2	E	98	

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Mol	Chain	Length	Quality of chain
2	F	98	 2% 64% 18% 6% 11%
2	G	98	 64% 18% 6% 11%
2	H	98	 % 62% 24% 6% 11%

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
5	MPD	G	65	X	-	-	-

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 3554 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.

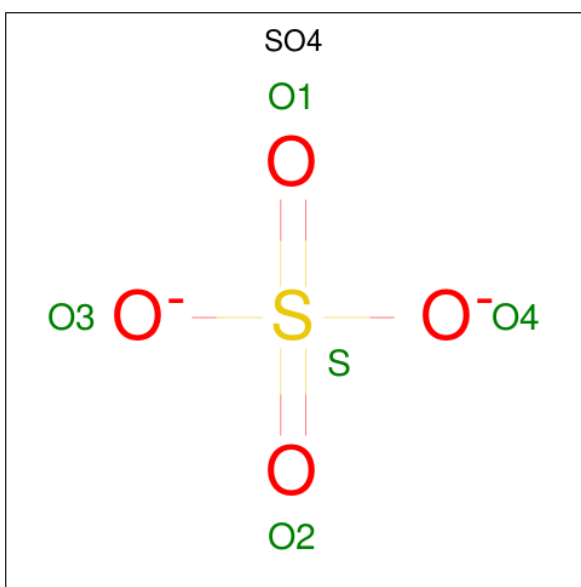
- Molecule 1 is a protein called Surface presentation of antigens protein spaS.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
1	A	20	Total	C	N	O	0	1	0
			164	100	27	37			
1	B	20	Total	C	N	O	0	0	0
			158	96	27	35			
1	C	19	Total	C	N	O	0	0	0
			149	91	26	32			
1	D	19	Total	C	N	O	0	0	0
			149	91	26	32			

- Molecule 2 is a protein called Surface presentation of antigens protein spaS.

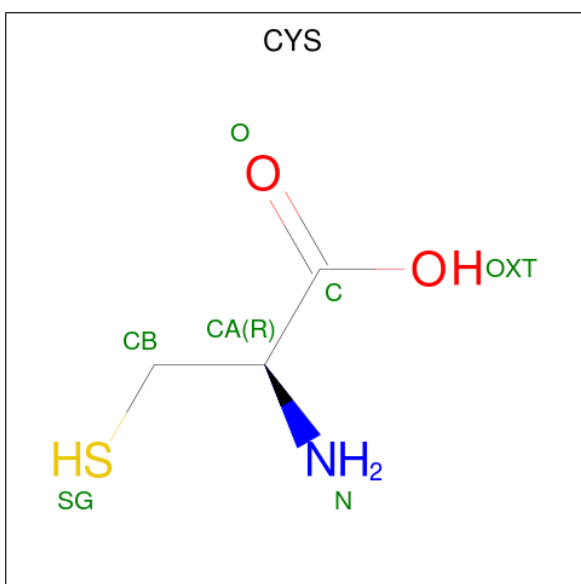
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	E	88	Total	C	N	O	S	0	0	0
			713	464	119	128	2			
2	F	87	Total	C	N	O	S	0	0	0
			706	459	118	127	2			
2	G	87	Total	C	N	O	S	0	1	0
			712	463	119	128	2			
2	H	87	Total	C	N	O	S	0	0	0
			706	459	118	127	2			

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



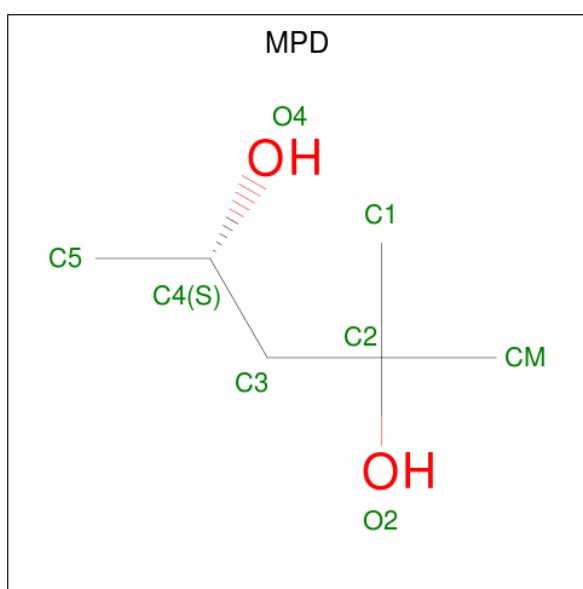
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	E	1	Total	O	S	0	0
			5	4	1		
3	F	1	Total	O	S	0	0
			5	4	1		
3	G	1	Total	O	S	0	0
			5	4	1		
3	H	1	Total	O	S	0	0
			5	4	1		
3	H	1	Total	O	S	0	0
			5	4	1		

- Molecule 4 is CYSTEINE (three-letter code: CYS) (formula: C<sub>3</sub>H<sub>7</sub>NO<sub>2</sub>S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	E	1	Total	C	N	O	S	0	0
			7	3	1	2	1		
4	F	1	Total	C	N	O	S	0	0
			7	3	1	2	1		
4	G	1	Total	C	N	O	S	0	0
			7	3	1	2	1		
4	H	1	Total	C	N	O	S	0	0
			7	3	1	2	1		

- Molecule 5 is (4S)-2-METHYL-2,4-PENTANEDIOL (three-letter code: MPD) (formula:  $C_6H_{14}O_2$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	G	1	Total	C	O	0	0
			8	6	2		

- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	8	Total	O	0	0
			8	8		
6	E	6	Total	O	0	0
			6	6		
6	B	2	Total	O	0	0
			2	2		
6	F	5	Total	O	0	0
			5	5		

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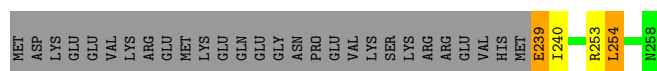
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	C	3	Total 3	O 3	0	0
6	G	4	Total 4	O 4	0	0
6	D	3	Total 3	O 3	0	0
6	H	5	Total 5	O 5	0	0

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

These plots are drawn for all protein, RNA and DNA 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.

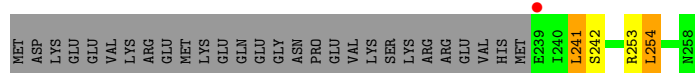
- Molecule 1: Surface presentation of antigens protein spaS

Chain A: 



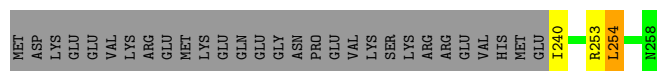
- Molecule 1: Surface presentation of antigens protein spaS

Chain B: 



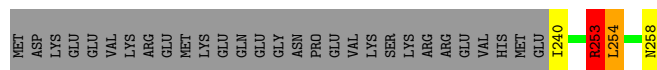
- Molecule 1: Surface presentation of antigens protein spaS

Chain C: 




- Molecule 1: Surface presentation of antigens protein spaS

Chain D: 



- Molecule 2: Surface presentation of antigens protein spaS

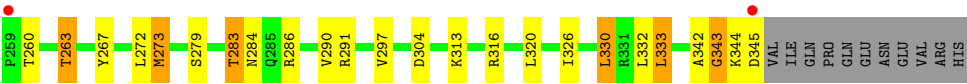
Chain E: 



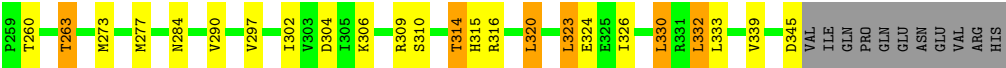
- Molecule 2: Surface presentation of antigens protein spaS

Chain F: 





• Molecule 2: Surface presentation of antigens protein spaS



• Molecule 2: Surface presentation of antigens protein spaS



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	96.66Å 96.66Å 217.51Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	83.62 – 2.60 40.22 – 2.60	Depositor EDS
% Data completeness (in resolution range)	99.4 (83.62-2.60) 99.5 (40.22-2.60)	Depositor EDS
$R_{merge}$	0.06	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.78 (at 2.61Å)	Xtriage
Refinement program	REFMAC	Depositor
R, $R_{free}$	0.223 , 0.254 0.227 , 0.257	Depositor DCC
$R_{free}$ test set	1831 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	60.5	Xtriage
Anisotropy	0.176	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 42.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.024 for -h,-k,l	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	3554	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	24.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.24% 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: MPD, SO4

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	0.93	0/166	0.95	1/221 (0.5%)
1	B	0.85	0/157	1.09	2/209 (1.0%)
1	C	0.85	0/148	0.86	0/197
1	D	0.80	0/148	1.00	1/197 (0.5%)
2	E	0.85	1/727 (0.1%)	0.86	2/987 (0.2%)
2	F	0.85	0/720	0.89	2/977 (0.2%)
2	G	0.84	0/729	0.80	1/989 (0.1%)
2	H	0.80	0/720	0.86	0/977
All	All	0.84	1/3515 (0.0%)	0.88	9/4754 (0.2%)

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	A	0	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	E	295	GLU	CG-CD	5.25	1.59	1.51

The worst 5 of 9 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	253	ARG	NE-CZ-NH2	6.67	123.64	120.30
2	F	304	ASP	CB-CG-OD1	6.14	123.83	118.30
2	E	291	ARG	NE-CZ-NH1	5.81	123.20	120.30
1	B	241	LEU	C-N-CA	5.75	136.08	121.70

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	E	316	ARG	NE-CZ-NH2	5.68	123.14	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	239	GLU	Peptide

## 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	164	0	166	0	0
1	B	158	0	160	0	0
1	C	149	0	154	1	0
1	D	149	0	154	4	0
2	E	713	0	743	12	0
2	F	706	0	734	9	0
2	G	712	0	742	14	0
2	H	706	0	734	11	0
3	E	5	0	0	1	0
3	F	5	0	0	0	0
3	G	5	0	0	0	0
3	H	10	0	0	0	0
4	E	7	0	4	0	0
4	F	7	0	4	0	0
4	G	7	0	4	0	0
4	H	7	0	4	0	0
5	G	8	0	14	0	0
6	A	8	0	0	0	0
6	B	2	0	0	0	0
6	C	3	0	0	0	0
6	D	3	0	0	0	0
6	E	6	0	0	0	0
6	F	5	0	0	0	0
6	G	4	0	0	0	0
6	H	5	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	3554	0	3617	48	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 7.

The worst 5 of 48 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:G:314:THR:HG22	2:G:315:HIS:ND1	1.82	0.94
2:G:314:THR:HG22	2:G:315:HIS:CE1	2.06	0.90
2:H:260:THR:HG23	2:H:284:ASN:ND2	1.96	0.80
2:G:339:VAL:O	2:H:273:MET:HE1	1.89	0.72
2:G:314:THR:CG2	2:G:315:HIS:CE1	2.75	0.69

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	19/48 (40%)	19 (100%)	0	0	100	100
1	B	18/48 (38%)	17 (94%)	0	1 (6%)	2	2
1	C	17/48 (35%)	17 (100%)	0	0	100	100
1	D	17/48 (35%)	17 (100%)	0	0	100	100
2	E	86/98 (88%)	85 (99%)	1 (1%)	0	100	100
2	F	85/98 (87%)	82 (96%)	2 (2%)	1 (1%)	14	30
2	G	86/98 (88%)	83 (96%)	3 (4%)	0	100	100
2	H	85/98 (87%)	82 (96%)	2 (2%)	1 (1%)	14	30
All	All	413/584 (71%)	402 (97%)	8 (2%)	3 (1%)	24	46

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	242	SER
2	F	344	LYS
2	H	271	GLU

### 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	20/46 (44%)	16 (80%)	4 (20%)	1	2
1	B	19/46 (41%)	16 (84%)	3 (16%)	3	4
1	C	18/46 (39%)	15 (83%)	3 (17%)	2	3
1	D	18/46 (39%)	16 (89%)	2 (11%)	7	12
2	E	79/89 (89%)	68 (86%)	11 (14%)	4	6
2	F	78/89 (88%)	64 (82%)	14 (18%)	2	3
2	G	79/89 (89%)	63 (80%)	16 (20%)	1	2
2	H	78/89 (88%)	63 (81%)	15 (19%)	1	2
All	All	389/540 (72%)	321 (82%)	68 (18%)	2	3

5 of 68 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	F	333	LEU
2	G	297	VAL
2	H	326	ILE
2	F	345	ASP
1	C	254	LEU

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

Mol	Chain	Res	Type
2	G	284	ASN
2	H	284	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 ⓘ

There are no carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

10 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	SO4	E	66	-	4,4,4	0.14	0	6,6,6	0.35	0
3	SO4	F	67	-	4,4,4	0.17	0	6,6,6	0.24	0
5	MPD	G	65	-	7,7,7	0.80	0	9,10,10	1.90	3 (33%)
3	SO4	G	68	-	4,4,4	0.20	0	6,6,6	0.31	0
3	SO4	H	64	-	4,4,4	0.25	0	6,6,6	0.58	0
3	SO4	H	69	-	4,4,4	0.16	0	6,6,6	0.32	0

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
5	MPD	G	65	-	1/1/2/2	2/5/5/5	-

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	G	65	MPD	CM-C2-C1	-3.92	102.32	110.57
5	G	65	MPD	O4-C4-C5	-2.23	99.96	109.43
5	G	65	MPD	O2-C2-CM	-2.01	101.58	108.06

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
5	G	65	MPD	C4

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	G	65	MPD	C1-C2-C3-C4
5	G	65	MPD	C2-C3-C4-C5

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 ⓘ

### 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, 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	20/48 (41%)	-0.27	0 100 100	11, 16, 23, 28	0
1	B	20/48 (41%)	-0.08	1 (5%) 29 22	17, 19, 34, 36	0
1	C	19/48 (39%)	-0.36	0 100 100	19, 22, 31, 33	0
1	D	19/48 (39%)	-0.48	0 100 100	15, 20, 25, 26	0
2	E	88/98 (89%)	-0.40	3 (3%) 45 37	9, 20, 39, 44	0
2	F	87/98 (88%)	-0.31	2 (2%) 60 54	16, 22, 32, 40	0
2	G	87/98 (88%)	-0.26	0 100 100	13, 26, 33, 43	0
2	H	87/98 (88%)	-0.31	1 (1%) 80 77	17, 25, 38, 39	0
All	All	427/584 (73%)	-0.32	7 (1%) 72 67	9, 23, 36, 44	0

The worst 5 of 7 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	F	345	ASP	3.8
1	B	239	GLU	3.4
2	E	346	VAL	3.4
2	E	345	ASP	2.1
2	H	345	ASP	2.1

### 6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

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

### 6.3 Carbohydrates ⓘ

There are no carbohydrates 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
3	SO4	G	68	5/5	0.62	0.29	79,80,80,81	5
5	MPD	G	65	8/8	0.67	0.31	76,78,81,82	0
3	SO4	H	64	5/5	0.79	0.23	89,89,90,92	0
3	SO4	F	67	5/5	0.80	0.26	75,75,76,77	5
3	SO4	E	66	5/5	0.86	0.22	63,64,64,65	5
4	CYS	F	62	7/7	0.89	0.22	91,92,92,92	0
4	CYS	H	63	7/7	0.89	0.29	90,91,91,91	0
4	CYS	G	60	7/7	0.91	0.23	75,77,78,81	0
3	SO4	H	69	5/5	0.94	0.30	57,58,59,59	5
4	CYS	E	61	7/7	0.94	0.26	84,86,87,87	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.