



# wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 31, 2023 – 09:57 PM EDT

PDB ID : 3HOT  
Title : Crystal structure of the Mos1 mariner paired end complex with Mn  
Authors : Richardson, J.M.; Walkinshaw, M.D.  
Deposited on : 2009-06-03  
Resolution : 3.25 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)

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<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 : 2.36  
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) : 2.36

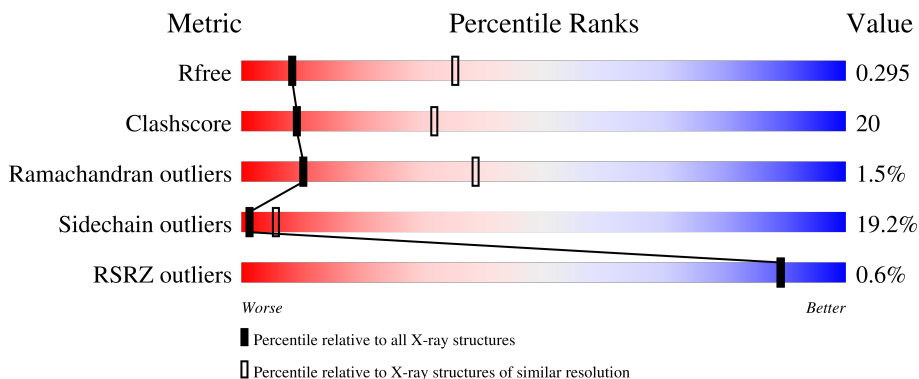
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.25 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.




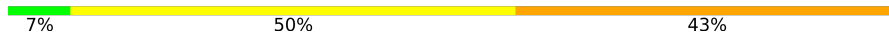

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	1191 (3.30-3.22)
Clashscore	141614	1251 (3.30-3.22)
Ramachandran outliers	138981	1229 (3.30-3.22)
Sidechain outliers	138945	1228 (3.30-3.22)
RSRZ outliers	127900	1154 (3.30-3.22)

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	345	
1	B	345	
2	C	25	
2	E	25	
2	G	25	

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Mol	Chain	Length	Quality of chain
3	D	28	 21% 39% 39%
3	F	28	 7% 50% 43%
3	H	28	 4% 7% 46% 46%

## 2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 8915 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 Transposable element mariner, complete cds.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	338	2822	1789	512	511	10	0	0	0
1	B	338	2821	1789	511	511	10	0	0	0

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	45	THR	LYS	SEE REMARK 999	UNP Q7JQ07
A	164	ASN	SER	SEE REMARK 999	UNP Q7JQ07
A	210	PRO	ARG	SEE REMARK 999	UNP Q7JQ07
A	216	ALA	THR	engineered mutation	UNP Q7JQ07
A	344	PHE	LEU	SEE REMARK 999	UNP Q7JQ07
B	45	THR	LYS	SEE REMARK 999	UNP Q7JQ07
B	164	ASN	SER	SEE REMARK 999	UNP Q7JQ07
B	210	PRO	ARG	SEE REMARK 999	UNP Q7JQ07
B	216	ALA	THR	engineered mutation	UNP Q7JQ07
B	344	PHE	LEU	SEE REMARK 999	UNP Q7JQ07

- Molecule 2 is a DNA chain called Mos1 NTS inverted repeat DNA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace	
			Total	C	I	N	O				P
2	C	25	520	247	1	94	153	25	0	0	0
2	E	25	520	247	1	94	153	25	0	0	0
2	G	25	520	247	1	94	153	25	0	0	0

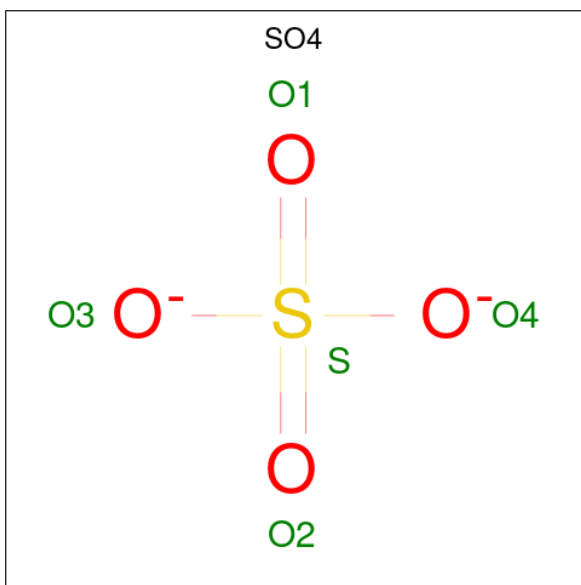
- Molecule 3 is a DNA chain called Mos1 TS inverted repeat DNA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	28	Total	C	N	O	P	0	0	0
			566	273	102	164	27			
3	F	28	Total	C	N	O	P	0	0	0
			566	273	102	164	27			
3	H	28	Total	C	N	O	P	0	0	0
			566	273	102	164	27			

- Molecule 4 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Mn	0	0
			1	1		

- Molecule 5 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	B	1	Total	O	S	0	0
			5	4	1		
5	D	1	Total	O	S	0	0
			5	4	1		

- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	1	Total	O	0	0
			1	1		

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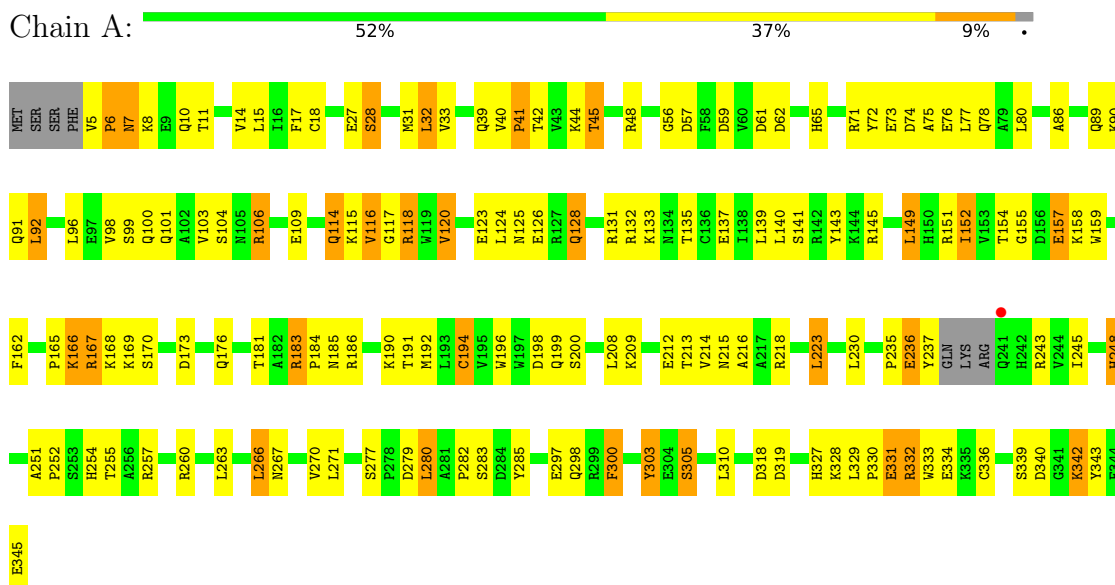
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Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	B	2	Total O 2 2	0	0

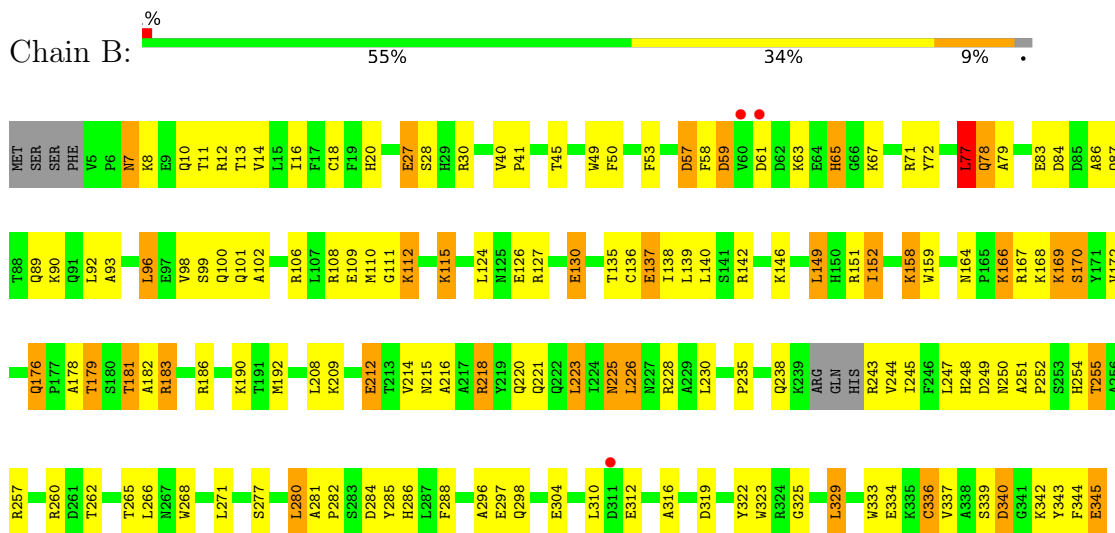
### 3 Residue-property plots [i](#)

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.

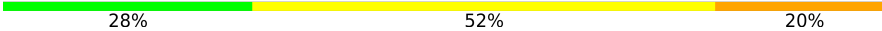
- Molecule 1: Transposable element mariner, complete cds



- Molecule 1: Transposable element mariner, complete cds



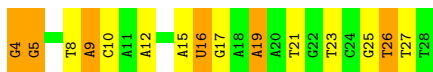
- Molecule 2: Mos1 NTS inverted repeat DNA

Chain C:  28% 52% 20%



- Molecule 2: Mos1 NTS inverted repeat DNA

Chain E:  40% 36% 24%




- Molecule 2: Mos1 NTS inverted repeat DNA

Chain G:  48% 48%



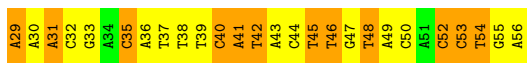
- Molecule 3: Mos1 TS inverted repeat DNA

Chain D:  21% 39% 39%



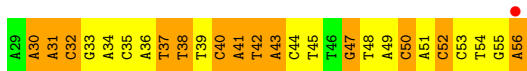
- Molecule 3: Mos1 TS inverted repeat DNA

Chain F:  7% 50% 43%



- Molecule 3: Mos1 TS inverted repeat DNA

Chain H:  4% 7% 46% 46%





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	120.29Å 84.99Å 132.12Å 90.00° 99.21° 90.00°	Depositor
Resolution (Å)	38.87 – 3.25 38.86 – 3.25	Depositor EDS
% Data completeness (in resolution range)	93.2 (38.87-3.25) 93.2 (38.86-3.25)	Depositor EDS
$R_{merge}$	0.17	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.80 (at 3.25Å)	Xtrriage
Refinement program	REFMAC 5.5.0072	Depositor
R, $R_{free}$	0.248 , 0.304 0.245 , 0.295	Depositor DCC
$R_{free}$ test set	1970 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	57.0	Xtrriage
Anisotropy	0.383	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.27 , 39.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.44$ , $\langle L^2 \rangle = 0.27$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.84	EDS
Total number of atoms	8915	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	50.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.36% 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 i

### 5.1 Standard geometry i

Bond lengths and bond angles in the following residue types are not validated in this section: 5IU, SO4, MN

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	0.58	0/2896	0.70	0/3908
1	B	0.59	2/2894 (0.1%)	0.68	1/3904 (0.0%)
2	C	0.96	1/560 (0.2%)	1.88	20/860 (2.3%)
2	E	1.00	1/560 (0.2%)	2.08	18/860 (2.1%)
2	G	0.91	1/560 (0.2%)	1.69	13/860 (1.5%)
3	D	0.91	0/634	1.86	27/975 (2.8%)
3	F	1.04	0/634	1.94	26/975 (2.7%)
3	H	0.83	0/634	1.74	24/975 (2.5%)
All	All	0.74	5/9372 (0.1%)	1.31	129/13317 (1.0%)

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
1	B	0	1
All	All	0	2

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	G	4	DG	OP3-P	-10.45	1.48	1.61
2	E	4	DG	OP3-P	-9.49	1.49	1.61
2	C	4	DG	OP3-P	-9.30	1.50	1.61
1	B	126	GLU	CD-OE2	7.98	1.34	1.25
1	B	345	GLU	CG-CD	5.06	1.59	1.51

The worst 5 of 129 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	E	4	DG	OP1-P-OP2	-22.35	86.07	119.60
2	E	4	DG	O5'-P-OP2	-15.18	92.04	105.70
2	C	13	DG	O4'-C4'-C3'	-12.75	98.35	106.00
3	F	48	DT	O4'-C4'-C3'	-10.11	99.93	106.00
2	E	25	DG	O4'-C1'-N9	10.08	115.06	108.00

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	266	LEU	Peptide
1	B	111	GLY	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	2822	0	2754	129	0
1	B	2821	0	2760	116	0
2	C	520	0	282	17	0
2	E	520	0	282	9	0
2	G	520	0	282	28	0
3	D	566	0	318	17	0
3	F	566	0	318	23	0
3	H	566	0	318	24	0
4	A	1	0	0	0	0
5	B	5	0	0	0	0
5	D	5	0	0	0	0
6	A	1	0	0	1	0
6	B	2	0	0	0	0
All	All	8915	0	7314	323	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 20.

The worst 5 of 323 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:B:282:PRO:HG3	1:B:329:LEU:HD21	1.30	1.14
1:A:106:ARG:HH21	1:A:106:ARG:HG3	1.14	1.02
1:A:100:GLN:HE22	2:C:9:DA:H62	1.03	0.98
1:A:209:LYS:O	1:A:212:GLU:HB2	1.64	0.98
1:A:139:LEU:HD21	1:A:271:LEU:HD22	1.47	0.96

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	334/345 (97%)	297 (89%)	31 (9%)	6 (2%)	8	35
1	B	334/345 (97%)	285 (85%)	45 (14%)	4 (1%)	13	43
All	All	668/690 (97%)	582 (87%)	76 (11%)	10 (2%)	10	39

5 of 10 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	41	PRO
1	B	250	ASN
1	A	75	ALA
1	A	267	ASN
1	B	58	PHE

#### 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	300/307 (98%)	238 (79%)	62 (21%)	1	4
1	B	300/307 (98%)	247 (82%)	53 (18%)	2	8
All	All	600/614 (98%)	485 (81%)	115 (19%)	1	6

5 of 115 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	310	LEU
1	B	336	CYS
1	B	77	LEU
1	B	329	LEU
1	B	218	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 22 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	91	GLN
1	B	101	GLN
1	B	100	GLN
1	B	114	GLN
1	A	176	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](#)

3 non-standard protein/DNA/RNA residues 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
2	5IU	E	16	2	18,21,22	1.65	5 (27%)	26,30,33	2.16	8 (30%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	5IU	G	16	2,3	18,21,22	1.34	3 (16%)	26,30,33	2.11	8 (30%)
2	5IU	C	16	2,3	18,21,22	1.83	5 (27%)	26,30,33	2.38	9 (34%)

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
2	5IU	E	16	2	-	2/7/21/22	0/2/2/2
2	5IU	G	16	2,3	-	1/7/21/22	0/2/2/2
2	5IU	C	16	2,3	-	1/7/21/22	0/2/2/2

The worst 5 of 13 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	16	5IU	C5-I5	4.18	2.20	2.08
2	E	16	5IU	C5-I5	3.48	2.18	2.08
2	C	16	5IU	C4-C5	3.33	1.53	1.45
2	C	16	5IU	C6-C5	3.18	1.44	1.35
2	G	16	5IU	C2-N1	3.18	1.43	1.38

The worst 5 of 25 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	G	16	5IU	C4-N3-C2	-5.20	120.61	127.35
2	C	16	5IU	C5-C4-N3	4.84	121.93	113.86
2	G	16	5IU	N3-C2-N1	4.78	121.24	114.89
2	E	16	5IU	C5-C4-N3	4.69	121.67	113.86
2	C	16	5IU	N3-C2-N1	4.23	120.51	114.89

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	E	16	5IU	C3'-C4'-C5'-O5'
2	E	16	5IU	O4'-C4'-C5'-O5'
2	C	16	5IU	C3'-C4'-C5'-O5'
2	G	16	5IU	C4'-C5'-O5'-P

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	E	16	5IU	1	0
2	G	16	5IU	2	0

## 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	$\# Z  > 2$
5	SO4	B	346	-	4,4,4	0.13	0	6,6,6	0.12	0
5	SO4	D	1	-	4,4,4	0.15	0	6,6,6	0.19	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.

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	338/345 (97%)	-0.04	1 (0%) 94 94	23, 48, 67, 86	0
1	B	338/345 (97%)	-0.02	3 (0%) 84 84	24, 49, 73, 84	0
2	C	24/25 (96%)	-0.25	0 100 100	32, 46, 65, 75	0
2	E	24/25 (96%)	-0.15	0 100 100	35, 48, 72, 81	0
2	G	24/25 (96%)	0.41	0 100 100	3, 53, 95, 112	0
3	D	28/28 (100%)	-0.24	0 100 100	30, 44, 55, 58	0
3	F	28/28 (100%)	-0.22	0 100 100	32, 48, 63, 68	0
3	H	28/28 (100%)	0.37	1 (3%) 42 39	8, 58, 89, 90	0
All	All	832/849 (97%)	-0.03	5 (0%) 89 89	3, 48, 73, 112	0

All (5) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	241	GLN	3.2
3	H	56	DA	2.9
1	B	311	ASP	2.6
1	B	61	ASP	2.1
1	B	60	VAL	2.1

### 6.2 Non-standard residues in protein, DNA, RNA chains [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
2	5IU	G	16	20/21	0.69	0.36	100,118,131,139	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
2	5IU	C	16	20/21	0.86	0.21	58,68,92,108	0
2	5IU	E	16	20/21	0.89	0.20	57,66,91,108	0

### 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
5	SO4	D	1	5/5	0.82	0.30	123,123,123,124	0
5	SO4	B	346	5/5	0.86	0.21	129,129,130,130	0
4	MN	A	1001	1/1	0.94	0.25	89,89,89,89	0

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

There are no such residues in this entry.