



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 25, 2024 – 04:31 PM EST

PDB ID : 5SVC  
Title : Mechanism of ATP-Dependent Acetone Carboxylation, Acetone Carboxylase nucleotide-free structure  
Authors : Eilers, B.J.; Mus, F.; Alleman, A.B.; Kabasakal, B.V.; Murray, J.W.; Nocek, B.P.; Dubois, J.L.; Peters, J.W.  
Deposited on : 2016-08-05  
Resolution : 2.70 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 : 2.36  
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

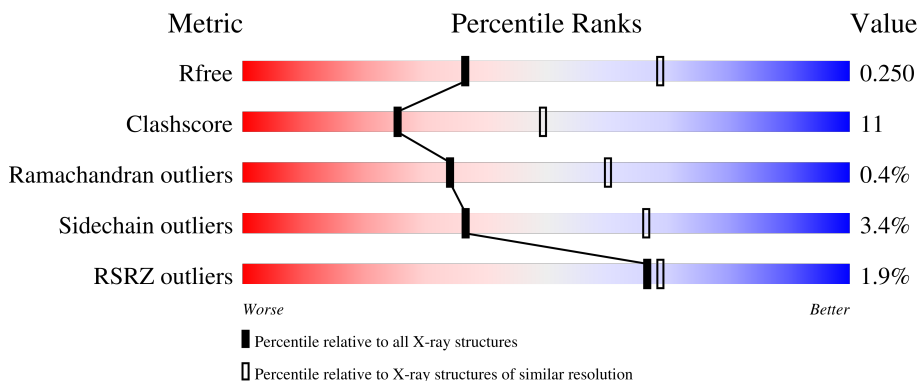
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.70 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	2808 (2.70-2.70)
Clashscore	141614	3122 (2.70-2.70)
Ramachandran outliers	138981	3069 (2.70-2.70)
Sidechain outliers	138945	3069 (2.70-2.70)
RSRZ outliers	127900	2737 (2.70-2.70)

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	776	74% 24% ..
1	D	776	71% 26% ..
2	B	727	72% 24% ..
2	E	727	71% 26% ..
3	C	168	73% 26% .

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Mol	Chain	Length	Quality of chain
3	F	168	 75% 24%

## 2 Entry composition [i](#)

There are 7 unique types of molecules in this entry. The entry contains 25811 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 Acetone carboxylase alpha subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	763	Total	C	N	O	S	0	0	0
			5992	3783	1050	1125	34			
1	D	763	Total	C	N	O	S	0	0	0
			5992	3783	1050	1125	34			

- Molecule 2 is a protein called Acetone carboxylase beta subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	710	Total	C	N	O	S	0	0	0
			5474	3446	954	1050	24			
2	E	710	Total	C	N	O	S	0	0	0
			5470	3443	953	1050	24			

There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	-9	MET	-	initiating methionine	UNP Q8RM04
B	-8	HIS	-	expression tag	UNP Q8RM04
B	-7	HIS	-	expression tag	UNP Q8RM04
B	-6	HIS	-	expression tag	UNP Q8RM04
B	-5	HIS	-	expression tag	UNP Q8RM04
B	-4	HIS	-	expression tag	UNP Q8RM04
B	-3	HIS	-	expression tag	UNP Q8RM04
B	-2	SER	-	expression tag	UNP Q8RM04
B	-1	SER	-	expression tag	UNP Q8RM04
B	0	GLY	-	expression tag	UNP Q8RM04
E	-9	MET	-	initiating methionine	UNP Q8RM04
E	-8	HIS	-	expression tag	UNP Q8RM04
E	-7	HIS	-	expression tag	UNP Q8RM04
E	-6	HIS	-	expression tag	UNP Q8RM04
E	-5	HIS	-	expression tag	UNP Q8RM04
E	-4	HIS	-	expression tag	UNP Q8RM04

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Chain	Residue	Modelled	Actual	Comment	Reference
E	-3	HIS	-	expression tag	UNP Q8RM04
E	-2	SER	-	expression tag	UNP Q8RM04
E	-1	SER	-	expression tag	UNP Q8RM04
E	0	GLY	-	expression tag	UNP Q8RM04

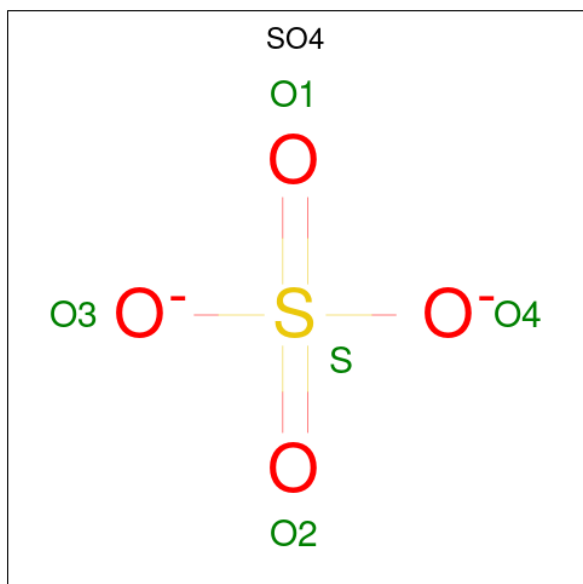
- Molecule 3 is a protein called Acetone carboxylase gamma subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	166	Total	C	N	O	S	0	0	0
			1379	892	229	249	9			
3	F	166	Total	C	N	O	S	0	0	0
			1379	892	229	249	9			

- 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		
4	D	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		

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

- Molecule 6 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	C	1	Total	Zn	0	0
			1	1		
6	F	1	Total	Zn	0	0
			1	1		

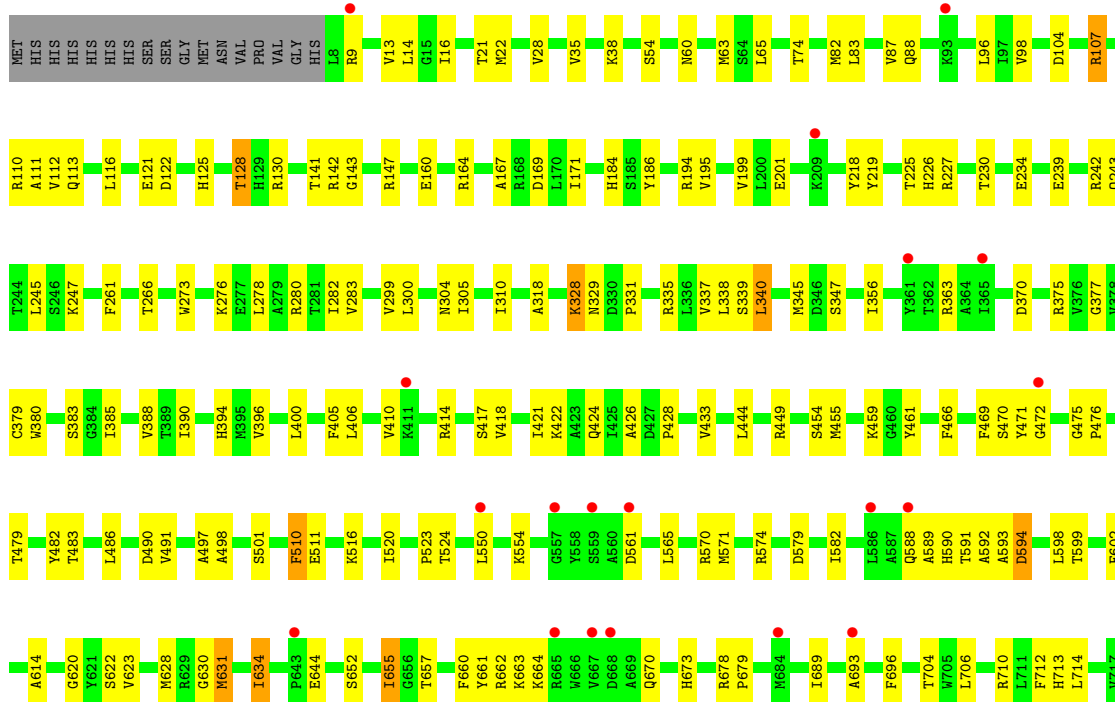
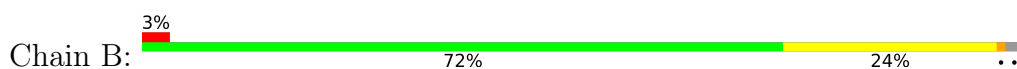
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	42	Total	O	0	0
			42	42		
7	B	10	Total	O	0	0
			10	10		
7	C	4	Total	O	0	0
			4	4		
7	D	40	Total	O	0	0
			40	40		
7	E	11	Total	O	0	0
			11	11		
7	F	4	Total	O	0	0
			4	4		

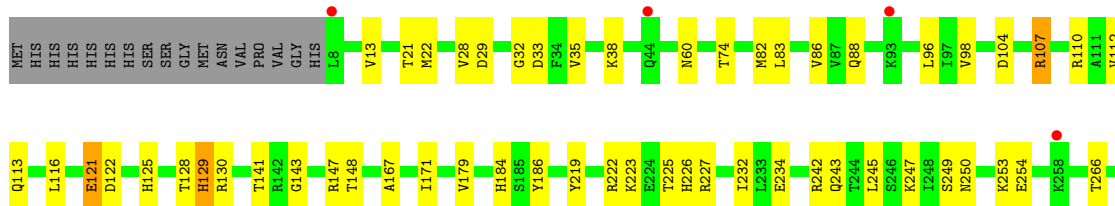




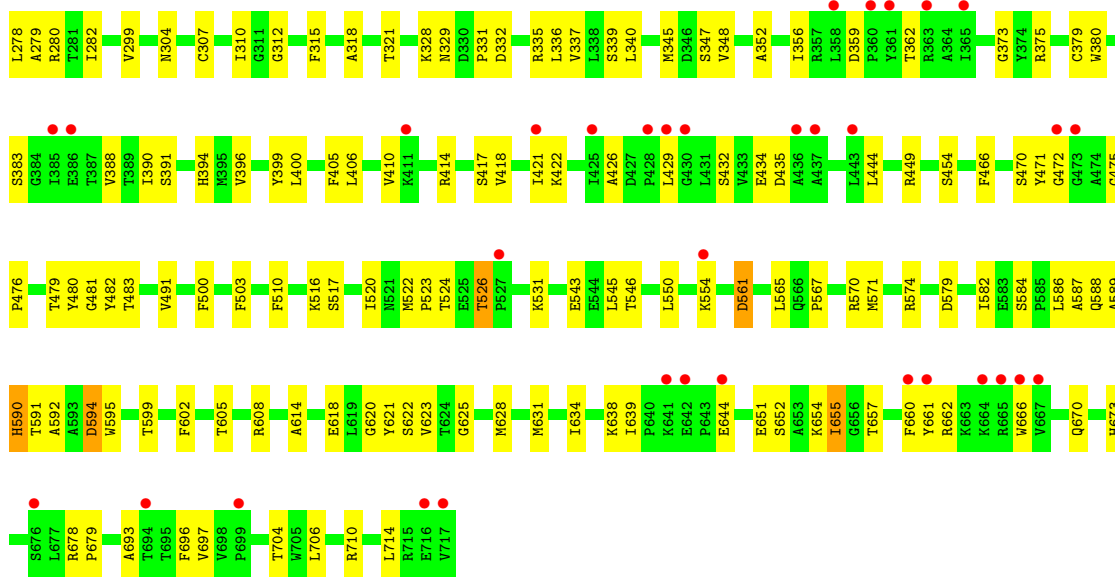
• Molecule 2: Acetone carboxylase beta subunit



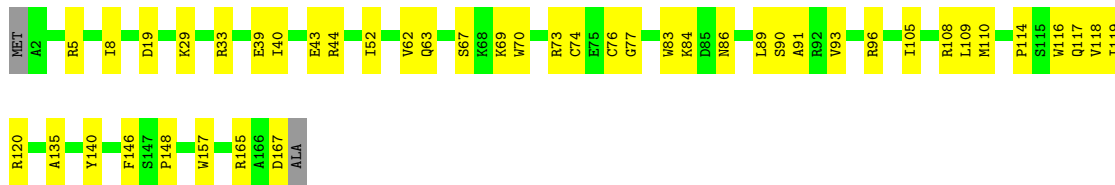
• Molecule 2: Acetone carboxylase beta subunit



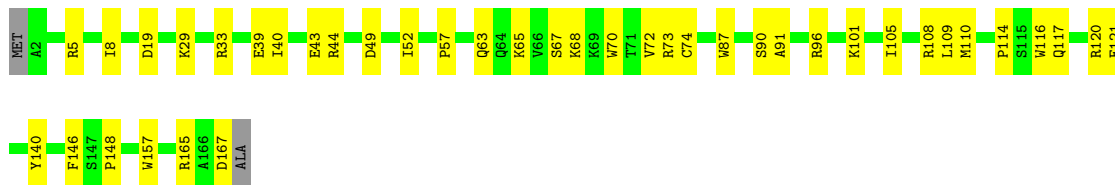




• Molecule 3: Acetone carboxylase gamma subunit



• Molecule 3: Acetone carboxylase gamma subunit



## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	76.76Å 265.16Å 122.17Å 90.00° 92.33° 90.00°	Depositor
Resolution (Å)	38.90 – 2.70 38.90 – 2.60	Depositor EDS
% Data completeness (in resolution range)	93.7 (38.90-2.70) 93.8 (38.90-2.60)	Depositor EDS
$R_{merge}$	0.14	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.78 (at 2.61Å)	Xtrriage
Refinement program	PHENIX (1.10_2155: ???)	Depositor
R, $R_{free}$	0.202 , 0.255 0.196 , 0.250	Depositor DCC
$R_{free}$ test set	6961 reflections (4.98%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	44.4	Xtrriage
Anisotropy	0.452	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 51.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.089 for h,-k,-l	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	25811	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	57.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.46% 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: MN, ZN, 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	0.55	1/6145 (0.0%)	0.73	0/8326
1	D	0.53	0/6145	0.74	2/8326 (0.0%)
2	B	0.44	1/5589 (0.0%)	0.63	0/7575
2	E	0.42	0/5585	0.62	0/7571
3	C	0.53	0/1426	0.68	0/1947
3	F	0.48	0/1426	0.61	0/1947
All	All	0.49	2/26316 (0.0%)	0.68	2/35692 (0.0%)

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	D	0	1
2	E	0	1
All	All	0	3

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	461	TYR	C-N	5.62	1.47	1.34
1	A	296	VAL	C-N	-5.46	1.23	1.34

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	632	LEU	CA-CB-CG	8.02	133.74	115.30
1	D	247	LEU	CA-CB-CG	5.29	127.46	115.30

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	436	SER	Peptide
1	D	436	SER	Peptide
2	E	587	ALA	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	5992	0	5749	128	0
1	D	5992	0	5749	140	0
2	B	5474	0	5391	123	0
2	E	5470	0	5380	124	0
3	C	1379	0	1337	31	0
3	F	1379	0	1337	28	0
4	A	1	0	0	0	0
4	D	1	0	0	0	0
5	B	5	0	0	0	0
5	E	5	0	0	0	0
6	C	1	0	0	0	0
6	F	1	0	0	0	0
7	A	42	0	0	2	0
7	B	10	0	0	1	0
7	C	4	0	0	0	0
7	D	40	0	0	5	0
7	E	11	0	0	1	0
7	F	4	0	0	1	0
All	All	25811	0	24943	536	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 11.

The worst 5 of 536 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:38:THR:HG21	1:A:43:GLY:HA2	1.53	0.90
1:D:38:THR:HG21	1:D:43:GLY:HA2	1.56	0.88
1:D:733:ARG:NH2	1:D:742:TRP:O	2.07	0.87
3:F:120:ARG:NH2	3:F:140:TYR:O	2.08	0.87
2:B:394:HIS:HB3	2:B:400:LEU:HG	1.55	0.87

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	761/776 (98%)	719 (94%)	39 (5%)	3 (0%)	34	60
1	D	761/776 (98%)	717 (94%)	40 (5%)	4 (0%)	29	54
2	B	708/727 (97%)	664 (94%)	42 (6%)	2 (0%)	41	66
2	E	708/727 (97%)	665 (94%)	40 (6%)	3 (0%)	34	60
3	C	164/168 (98%)	157 (96%)	7 (4%)	0	100	100
3	F	164/168 (98%)	158 (96%)	6 (4%)	0	100	100
All	All	3266/3342 (98%)	3080 (94%)	174 (5%)	12 (0%)	34	60

5 of 12 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	437	ASN
1	D	437	ASN
1	A	551	GLY
2	B	112	VAL
2	B	592	ALA

### 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	612/622 (98%)	592 (97%)	20 (3%)	38	67
1	D	612/622 (98%)	589 (96%)	23 (4%)	33	62
2	B	574/589 (98%)	552 (96%)	22 (4%)	33	62
2	E	573/589 (97%)	552 (96%)	21 (4%)	34	63
3	C	155/156 (99%)	152 (98%)	3 (2%)	57	82
3	F	155/156 (99%)	152 (98%)	3 (2%)	57	82
All	All	2681/2734 (98%)	2589 (97%)	92 (3%)	37	66

5 of 92 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	247	LEU
2	E	129	HIS
1	D	330	TRP
1	D	591	ASP
2	E	391	SER

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

Mol	Chain	Res	Type
1	D	437	ASN
1	D	620	ASN

### 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 6 ligands modelled in this entry, 4 are 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	801	-	4,4,4	0.18	0	6,6,6	0.51	0
5	SO4	E	801	-	4,4,4	0.20	0	6,6,6	0.48	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	763/776 (98%)	-0.14	2 (0%) 94 95	27, 45, 63, 108	0
1	D	763/776 (98%)	-0.11	4 (0%) 91 92	32, 46, 65, 97	0
2	B	710/727 (97%)	0.03	19 (2%) 54 55	35, 65, 98, 123	0
2	E	710/727 (97%)	0.14	38 (5%) 25 24	34, 64, 108, 134	0
3	C	166/168 (98%)	-0.39	0 100 100	33, 49, 67, 84	0
3	F	166/168 (98%)	-0.36	0 100 100	38, 53, 70, 92	0
All	All	3278/3342 (98%)	-0.06	63 (1%) 66 69	27, 52, 94, 134	0

The worst 5 of 63 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	E	436	ALA	4.0
2	E	437	ALA	3.8
2	E	361	TYR	3.6
2	E	699	PRO	3.5
2	E	472	GLY	3.5

### 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
5	SO4	E	801	5/5	0.89	0.32	97,104,106,113	0
5	SO4	B	801	5/5	0.93	0.27	73,75,88,89	0
4	MN	A	801	1/1	0.98	0.14	31,31,31,31	0
6	ZN	C	201	1/1	0.98	0.04	53,53,53,53	1
6	ZN	F	201	1/1	0.98	0.06	52,52,52,52	1
4	MN	D	801	1/1	0.99	0.13	28,28,28,28	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.