



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 1, 2016 – 11:56 AM GMT

PDB ID : 3QD9  
Title : C72S/C353S mutant of Trypanosoma brucei QSOX containing an interdomain disulfide  
Authors : Alon, A.; Fass, D.  
Deposited on : 2011-01-18  
Resolution : 3.30 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  
<http://wwpdb.org/validation/2016/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 : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

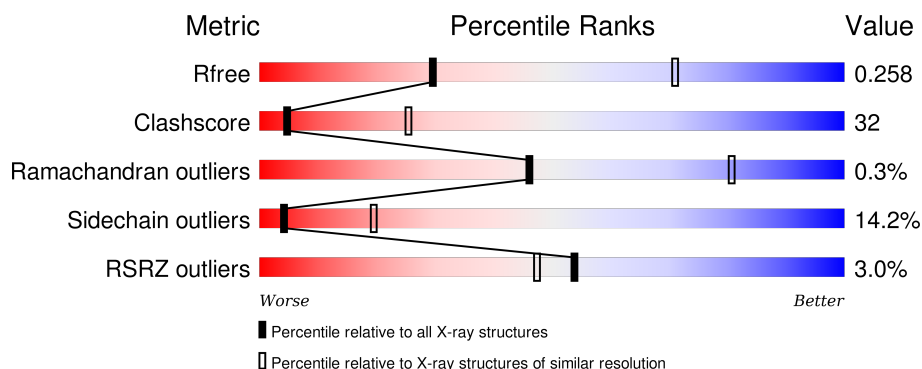
# 1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 3.30 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))
$R_{free}$	91344	2060 (3.40-3.20)
Clashscore	102246	1058 (3.38-3.22)
Ramachandran outliers	100387	1038 (3.38-3.22)
Sidechain outliers	100360	1037 (3.38-3.22)
RSRZ outliers	91569	2070 (3.40-3.20)

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 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	470	<div> <div>2%</div> <div>43% 33% 7% 17%</div> </div>
1	B	470	<div> <div>2%</div> <div>42% 34% 7% 17%</div> </div>
1	C	470	<div> <div>3%</div> <div>42% 33% 6% 18%</div> </div>
1	D	470	<div> <div>3%</div> <div>40% 35% 7% 18%</div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 12535 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 QSOX from Trypanosoma brucei (TbQSOX).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	388	Total	C	N	O	S	0	0	0
			3065	1952	530	569	14			
1	B	390	Total	C	N	O	S	0	0	0
			3102	1974	542	572	14			
1	C	385	Total	C	N	O	S	0	0	0
			3072	1955	537	566	14			
1	D	384	Total	C	N	O	S	0	0	0
			3067	1953	534	566	14			

There are 24 discrepancies between the modelled and reference sequences:

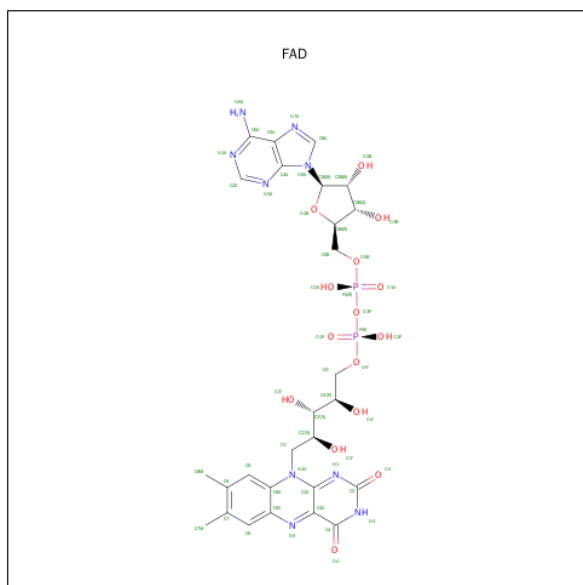
Chain	Residue	Modelled	Actual	Comment	Reference
A	16	GLY	-	EXPRESSION TAG	UNP Q585M6
A	17	SER	-	EXPRESSION TAG	UNP Q585M6
A	18	HIS	-	EXPRESSION TAG	UNP Q585M6
A	19	MET	-	EXPRESSION TAG	UNP Q585M6
A	72	SER	CYS	ENGINEERED MUTATION	UNP Q585M6
A	353	SER	CYS	ENGINEERED MUTATION	UNP Q585M6
B	16	GLY	-	EXPRESSION TAG	UNP Q585M6
B	17	SER	-	EXPRESSION TAG	UNP Q585M6
B	18	HIS	-	EXPRESSION TAG	UNP Q585M6
B	19	MET	-	EXPRESSION TAG	UNP Q585M6
B	72	SER	CYS	ENGINEERED MUTATION	UNP Q585M6
B	353	SER	CYS	ENGINEERED MUTATION	UNP Q585M6
C	16	GLY	-	EXPRESSION TAG	UNP Q585M6
C	17	SER	-	EXPRESSION TAG	UNP Q585M6
C	18	HIS	-	EXPRESSION TAG	UNP Q585M6
C	19	MET	-	EXPRESSION TAG	UNP Q585M6
C	72	SER	CYS	ENGINEERED MUTATION	UNP Q585M6
C	353	SER	CYS	ENGINEERED MUTATION	UNP Q585M6
D	16	GLY	-	EXPRESSION TAG	UNP Q585M6
D	17	SER	-	EXPRESSION TAG	UNP Q585M6
D	18	HIS	-	EXPRESSION TAG	UNP Q585M6

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Chain	Residue	Modelled	Actual	Comment	Reference
D	19	MET	-	EXPRESSION TAG	UNP Q585M6
D	72	SER	CYS	ENGINEERED MUTATION	UNP Q585M6
D	353	SER	CYS	ENGINEERED MUTATION	UNP Q585M6

- Molecule 2 is FLAVIN-ADENINE DINUCLEOTIDE (three-letter code: FAD) (formula:  $C_{27}H_{33}N_9O_{15}P_2$ ).

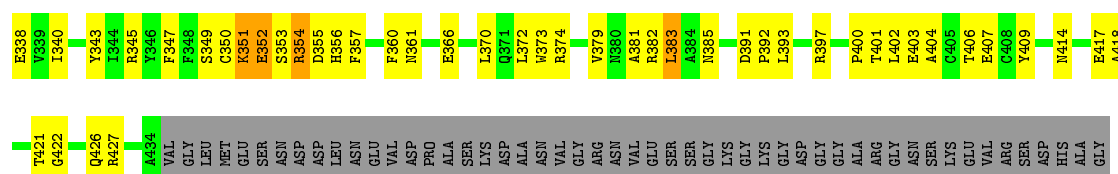


Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			53	27	9	15	2		
2	B	1	Total	C	N	O	P	0	0
			53	27	9	15	2		
2	C	1	Total	C	N	O	P	0	0
			53	27	9	15	2		
2	D	1	Total	C	N	O	P	0	0
			53	27	9	15	2		

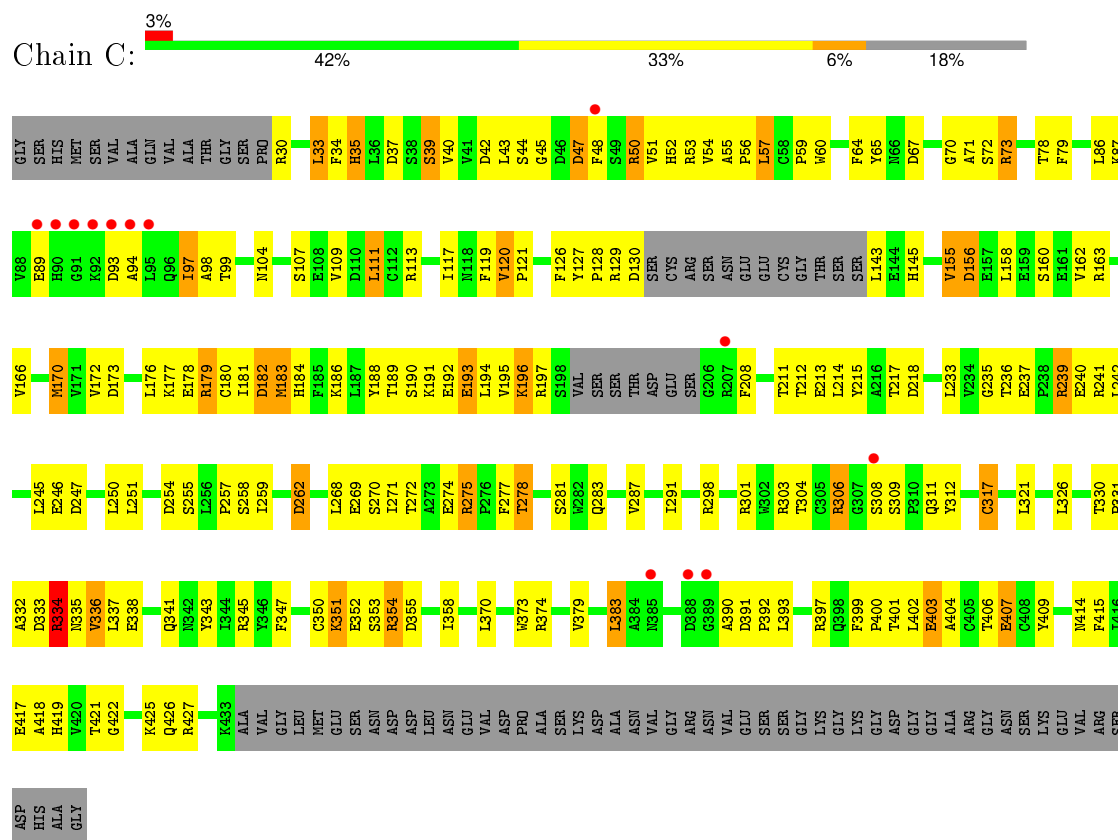
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	5	Total	O	0	0
			5	5		
3	B	7	Total	O	0	0
			7	7		
3	C	5	Total	O	0	0
			5	5		

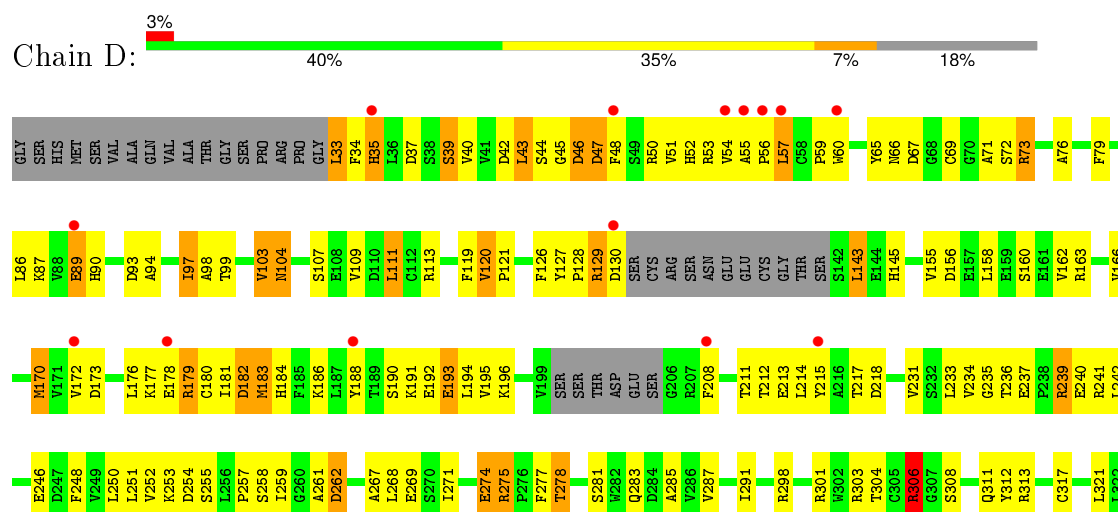


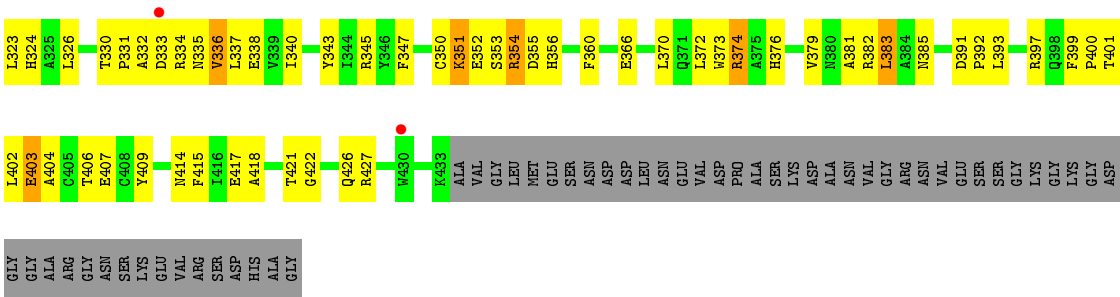


• Molecule 1: QSOX from *Trypanosoma brucei* (TbQSOX)



• Molecule 1: QSOX from *Trypanosoma brucei* (TbQSOX)





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	81.04Å 120.31Å 106.22Å 90.00° 105.44° 90.00°	Depositor
Resolution (Å)	38.11 – 3.30 40.75 – 3.30	Depositor EDS
% Data completeness (in resolution range)	98.6 (38.11-3.30) 98.5 (40.75-3.30)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.17 (at 3.32Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.7_629)	Depositor
R, $R_{free}$	0.190 , 0.249 0.211 , 0.258	Depositor DCC
$R_{free}$ test set	2939 reflections (11.18%)	DCC
Wilson B-factor (Å <sup>2</sup> )	79.3	Xtriage
Anisotropy	0.202	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.30 , 89.1	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Outliers	1 of 29246 reflections (0.003%)	Xtriage
$F_o, F_c$ correlation	0.92	EDS
Total number of atoms	12535	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	91.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.86% 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, 0.375 respectively for untwinned datasets, and 0.333, 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: FAD

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	0.76	3/3143 (0.1%)	0.96	16/4270 (0.4%)
1	B	0.81	7/3181 (0.2%)	0.91	15/4318 (0.3%)
1	C	0.79	5/3150 (0.2%)	0.89	9/4275 (0.2%)
1	D	0.73	4/3144 (0.1%)	0.90	10/4266 (0.2%)
All	All	0.77	19/12618 (0.2%)	0.91	50/17129 (0.3%)

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	B	0	1
1	D	0	1
All	All	0	2

The worst 5 of 19 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	237	GLU	CD-OE2	11.28	1.38	1.25
1	C	89	GLU	CB-CG	-9.21	1.34	1.52
1	B	274	GLU	CB-CG	-8.15	1.36	1.52
1	B	89	GLU	CB-CG	-7.11	1.38	1.52
1	A	53	ARG	NE-CZ	6.79	1.41	1.33

The worst 5 of 50 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	271	ILE	CG1-CB-CG2	-19.92	67.57	111.40
1	A	53	ARG	NE-CZ-NH1	12.17	126.39	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	89	GLU	CA-CB-CG	10.36	136.19	113.40
1	A	53	ARG	NE-CZ-NH2	-10.07	115.27	120.30
1	D	298	ARG	NE-CZ-NH2	-9.69	115.45	120.30

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	108	GLU	Mainchain
1	D	104	ASN	Sidechain

## 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	3065	0	2920	198	0
1	B	3102	0	2986	190	2
1	C	3072	0	2957	196	2
1	D	3067	0	2959	205	0
2	A	53	0	31	9	0
2	B	53	0	31	3	0
2	C	53	0	31	2	0
2	D	53	0	31	12	0
3	A	5	0	0	1	0
3	B	7	0	0	3	0
3	C	5	0	0	0	0
All	All	12535	0	11946	778	2

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 32.

The worst 5 of 778 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:D:376:HIS:CE1	2:D:501:FAD:H52A	1.70	1.25

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:376:HIS:HE1	2:D:501:FAD:H52A	1.01	1.06
1:C:193:GLU:OE1	1:C:193:GLU:HA	1.51	1.06
1:A:193:GLU:HA	1:A:193:GLU:OE1	1.52	1.05
1:B:258:SER:HA	3:B:602:HOH:O	1.55	1.04

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:274:GLU:OE2	1:C:247:ASP:OD1[2_655]	1.60	0.60
1:B:275:ARG:NE	1:C:239:ARG:NH1[2_655]	1.90	0.30

## 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	382/470 (81%)	358 (94%)	23 (6%)	1 (0%)	46	81
1	B	384/470 (82%)	360 (94%)	23 (6%)	1 (0%)	46	81
1	C	379/470 (81%)	355 (94%)	23 (6%)	1 (0%)	46	81
1	D	378/470 (80%)	352 (93%)	25 (7%)	1 (0%)	46	81
All	All	1523/1880 (81%)	1425 (94%)	94 (6%)	4 (0%)	46	81

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	336	VAL
1	B	336	VAL
1	C	336	VAL
1	D	336	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	328/400 (82%)	282 (86%)	46 (14%)	4	20
1	B	335/400 (84%)	288 (86%)	47 (14%)	4	20
1	C	332/400 (83%)	286 (86%)	46 (14%)	4	20
1	D	333/400 (83%)	283 (85%)	50 (15%)	3	17
All	All	1328/1600 (83%)	1139 (86%)	189 (14%)	4	19

5 of 189 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	336	VAL
1	C	155	VAL
1	D	262	ASP
1	B	361	ASN
1	C	39	SER

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

Mol	Chain	Res	Type
1	C	35	HIS
1	D	361	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 carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

4 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	$\# Z  > 2$
2	FAD	A	501	-	48,58,58	1.41	7 (14%)	54,89,89	2.76	15 (27%)
2	FAD	B	501	-	48,58,58	1.52	8 (16%)	54,89,89	2.10	9 (16%)
2	FAD	C	501	-	48,58,58	1.40	6 (12%)	54,89,89	2.29	11 (20%)
2	FAD	D	501	-	48,58,58	1.42	6 (12%)	54,89,89	2.29	15 (27%)

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	FAD	A	501	-	-	0/30/50/50	0/6/6/6
2	FAD	B	501	-	-	0/30/50/50	0/6/6/6
2	FAD	C	501	-	-	0/30/50/50	0/6/6/6
2	FAD	D	501	-	-	0/30/50/50	0/6/6/6

The worst 5 of 27 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	501	FAD	PA-O2A	-3.82	1.38	1.54
2	B	501	FAD	C6-C5X	-3.06	1.37	1.41
2	A	501	FAD	C10-N10	-2.96	1.35	1.39
2	B	501	FAD	PA-O1A	-2.86	1.40	1.51
2	B	501	FAD	O4B-C4B	-2.31	1.39	1.45

The worst 5 of 50 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
2	A	501	FAD	N3A-C2A-N1A	-12.80	119.09	128.89
2	C	501	FAD	N3A-C2A-N1A	-10.31	121.00	128.89
2	B	501	FAD	N3A-C2A-N1A	-9.81	121.39	128.89
2	D	501	FAD	N3A-C2A-N1A	-9.52	121.61	128.89
2	A	501	FAD	O3P-PA-O5B	-5.20	89.13	102.94

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

4 monomers are involved in 26 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	501	FAD	9	0
2	B	501	FAD	3	0
2	C	501	FAD	2	0
2	D	501	FAD	12	0

## 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	388/470 (82%)	-0.05	9 (2%) 64 57	42, 82, 149, 216	0
1	B	390/470 (82%)	-0.12	8 (2%) 67 60	29, 81, 145, 223	0
1	C	385/470 (81%)	0.03	13 (3%) 49 42	38, 83, 147, 248	0
1	D	384/470 (81%)	0.21	16 (4%) 40 33	55, 97, 151, 204	0
All	All	1547/1880 (82%)	0.01	46 (2%) 54 47	29, 86, 149, 248	0

The worst 5 of 46 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	201	SER	6.0
1	A	200	SER	5.5
1	D	35	HIS	4.1
1	C	92	LYS	3.9
1	B	205	SER	3.8

### 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 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
2	FAD	A	501	53/53	0.96	0.20	-0.54	21,53,79,103	0
2	FAD	B	501	53/53	0.96	0.19	-0.59	0,42,66,150	0
2	FAD	C	501	53/53	0.97	0.17	-0.83	7,48,77,99	0
2	FAD	D	501	53/53	0.95	0.17	-0.94	18,70,98,107	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.