



# Full wwPDB X-ray Structure Validation Report ⓘ

May 16, 2020 – 10:00 am BST

PDB ID : 3QFA  
Title : Crystal structure of the human thioredoxin reductase-thioredoxin complex  
Authors : Fritz-Wolf, K.; Kehr, S.; Stumpf, M.; Rahlfs, S.; Becker, K.  
Deposited on : 2011-01-21  
Resolution : 2.20 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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 : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.11  
buster-report : 1.1.7 (2018)  
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) : 2.11

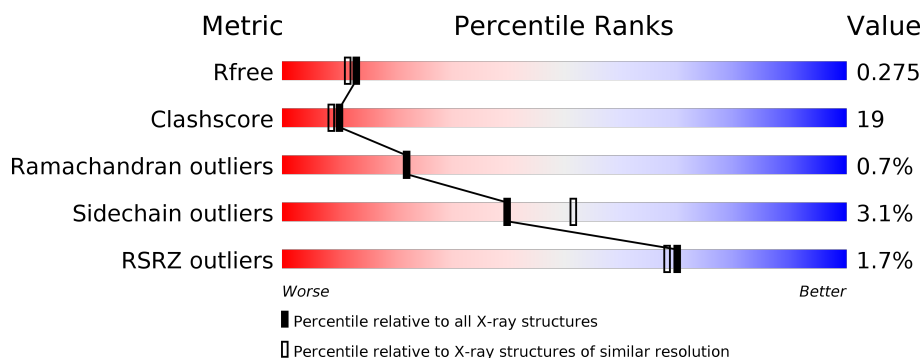
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.20 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	4898 (2.20-2.20)
Clashscore	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (2.20-2.20)
RSRZ outliers	127900	4800 (2.20-2.20)

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 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	519	<div> <div style="width: 100%; height: 10px; background-color: red;"></div> <div style="display: flex; justify-content: space-between;"> <span>66%</span> <span>28%</span> <span>• 5%</span> </div> </div>
1	B	519	<div> <div style="width: 100%; height: 10px; background-color: red;"></div> <div style="display: flex; justify-content: space-between;"> <span>67%</span> <span>27%</span> <span>• 5%</span> </div> </div>
2	C	116	<div> <div style="width: 100%; height: 10px; background-color: red;"></div> <div style="display: flex; justify-content: space-between;"> <span>7%</span> <span>48%</span> <span>40%</span> <span>• 9%</span> </div> </div>
2	D	116	<div> <div style="width: 100%; height: 10px; background-color: red;"></div> <div style="display: flex; justify-content: space-between;"> <span>3%</span> <span>47%</span> <span>41%</span> <span>• 9%</span> </div> </div>

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 crite-

ria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	GOL	A	801	-	X	-	-
4	GOL	A	802	-	X	-	-
4	GOL	A	803	-	X	-	-
4	GOL	A	804	-	X	-	-
4	GOL	B	804	-	X	-	-
4	GOL	D	803	-	X	-	-

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 9821 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 Thioredoxin reductase 1, cytoplasmic.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	494	Total	C	N	O	S	0	0	0
			3808	2418	650	720	20			
1	B	494	Total	C	N	O	S	0	0	0
			3808	2418	650	720	20			

There are 44 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	EXPRESSION TAG	UNP Q16881
A	-18	GLY	-	EXPRESSION TAG	UNP Q16881
A	-17	SER	-	EXPRESSION TAG	UNP Q16881
A	-16	SER	-	EXPRESSION TAG	UNP Q16881
A	-15	HIS	-	EXPRESSION TAG	UNP Q16881
A	-14	HIS	-	EXPRESSION TAG	UNP Q16881
A	-13	HIS	-	EXPRESSION TAG	UNP Q16881
A	-12	HIS	-	EXPRESSION TAG	UNP Q16881
A	-11	HIS	-	EXPRESSION TAG	UNP Q16881
A	-10	HIS	-	EXPRESSION TAG	UNP Q16881
A	-9	SER	-	EXPRESSION TAG	UNP Q16881
A	-8	SER	-	EXPRESSION TAG	UNP Q16881
A	-7	GLY	-	EXPRESSION TAG	UNP Q16881
A	-6	LEU	-	EXPRESSION TAG	UNP Q16881
A	-5	VAL	-	EXPRESSION TAG	UNP Q16881
A	-4	PRO	-	EXPRESSION TAG	UNP Q16881
A	-3	ARG	-	EXPRESSION TAG	UNP Q16881
A	-2	GLY	-	EXPRESSION TAG	UNP Q16881
A	-1	SER	-	EXPRESSION TAG	UNP Q16881
A	0	HIS	-	EXPRESSION TAG	UNP Q16881
A	497	SER	CYS	ENGINEERED MUTATION	UNP Q16881
A	498	CYS	U	SEE REMARK 999	UNP Q16881
B	-19	MET	-	EXPRESSION TAG	UNP Q16881
B	-18	GLY	-	EXPRESSION TAG	UNP Q16881
B	-17	SER	-	EXPRESSION TAG	UNP Q16881

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-16	SER	-	EXPRESSION TAG	UNP Q16881
B	-15	HIS	-	EXPRESSION TAG	UNP Q16881
B	-14	HIS	-	EXPRESSION TAG	UNP Q16881
B	-13	HIS	-	EXPRESSION TAG	UNP Q16881
B	-12	HIS	-	EXPRESSION TAG	UNP Q16881
B	-11	HIS	-	EXPRESSION TAG	UNP Q16881
B	-10	HIS	-	EXPRESSION TAG	UNP Q16881
B	-9	SER	-	EXPRESSION TAG	UNP Q16881
B	-8	SER	-	EXPRESSION TAG	UNP Q16881
B	-7	GLY	-	EXPRESSION TAG	UNP Q16881
B	-6	LEU	-	EXPRESSION TAG	UNP Q16881
B	-5	VAL	-	EXPRESSION TAG	UNP Q16881
B	-4	PRO	-	EXPRESSION TAG	UNP Q16881
B	-3	ARG	-	EXPRESSION TAG	UNP Q16881
B	-2	GLY	-	EXPRESSION TAG	UNP Q16881
B	-1	SER	-	EXPRESSION TAG	UNP Q16881
B	0	HIS	-	EXPRESSION TAG	UNP Q16881
B	497	SER	CYS	ENGINEERED MUTATION	UNP Q16881
B	498	CYS	U	SEE REMARK 999	UNP Q16881

- Molecule 2 is a protein called Thioredoxin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	105	Total	C	N	O	S	0	0	0
			819	523	128	163	5			
2	D	105	Total	C	N	O	S	0	0	0
			819	523	128	163	5			

There are 28 discrepancies between the modelled and reference sequences:

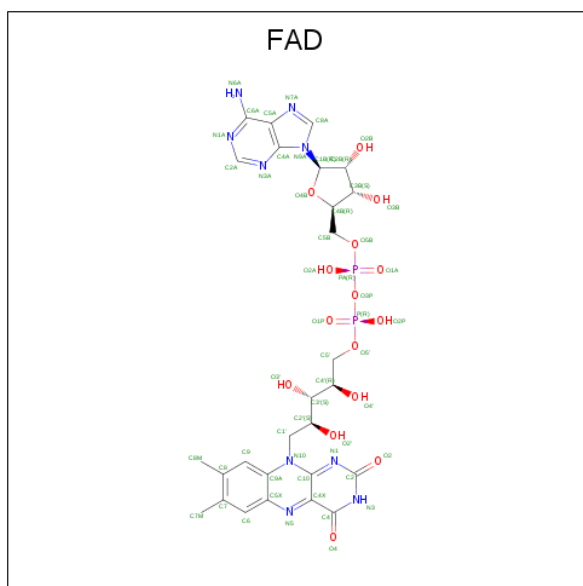
Chain	Residue	Modelled	Actual	Comment	Reference
C	-10	MET	-	EXPRESSION TAG	UNP P10599
C	-9	ARG	-	EXPRESSION TAG	UNP P10599
C	-8	GLY	-	EXPRESSION TAG	UNP P10599
C	-7	SER	-	EXPRESSION TAG	UNP P10599
C	-6	HIS	-	EXPRESSION TAG	UNP P10599
C	-5	HIS	-	EXPRESSION TAG	UNP P10599
C	-4	HIS	-	EXPRESSION TAG	UNP P10599
C	-3	HIS	-	EXPRESSION TAG	UNP P10599
C	-2	HIS	-	EXPRESSION TAG	UNP P10599
C	-1	HIS	-	EXPRESSION TAG	UNP P10599
C	0	GLY	-	EXPRESSION TAG	UNP P10599

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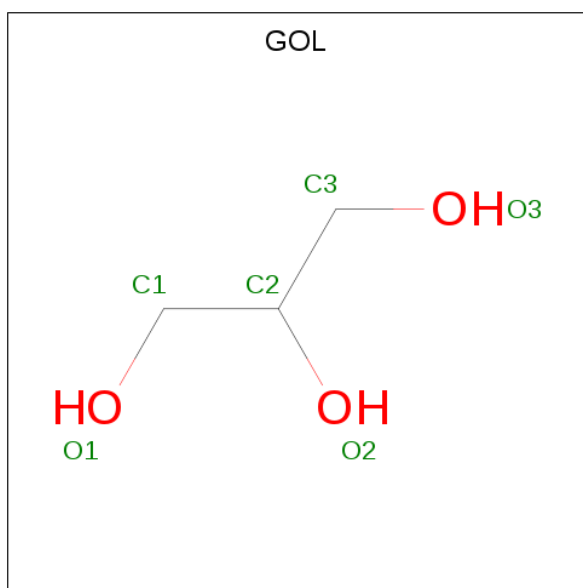
Chain	Residue	Modelled	Actual	Comment	Reference
C	1	SER	-	EXPRESSION TAG	UNP P10599
C	35	SER	CYS	ENGINEERED MUTATION	UNP P10599
C	73	SER	CYS	ENGINEERED MUTATION	UNP P10599
D	-10	MET	-	EXPRESSION TAG	UNP P10599
D	-9	ARG	-	EXPRESSION TAG	UNP P10599
D	-8	GLY	-	EXPRESSION TAG	UNP P10599
D	-7	SER	-	EXPRESSION TAG	UNP P10599
D	-6	HIS	-	EXPRESSION TAG	UNP P10599
D	-5	HIS	-	EXPRESSION TAG	UNP P10599
D	-4	HIS	-	EXPRESSION TAG	UNP P10599
D	-3	HIS	-	EXPRESSION TAG	UNP P10599
D	-2	HIS	-	EXPRESSION TAG	UNP P10599
D	-1	HIS	-	EXPRESSION TAG	UNP P10599
D	0	GLY	-	EXPRESSION TAG	UNP P10599
D	1	SER	-	EXPRESSION TAG	UNP P10599
D	35	SER	CYS	ENGINEERED MUTATION	UNP P10599
D	73	SER	CYS	ENGINEERED MUTATION	UNP P10599

- Molecule 3 is FLAVIN-ADENINE DINUCLEOTIDE (three-letter code: FAD) (formula:  $C_{27}H_{33}N_9O_{15}P_2$ ).



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

- Molecule 4 is GLYCEROL (three-letter code: GOL) (formula:  $C_3H_8O_3$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			6	3	3		
4	A	1	Total	C	O	0	0
			6	3	3		
4	A	1	Total	C	O	0	0
			6	3	3		
4	A	1	Total	C	O	0	0
			6	3	3		
4	B	1	Total	C	O	0	0
			6	3	3		
4	D	1	Total	C	O	0	0
			6	3	3		

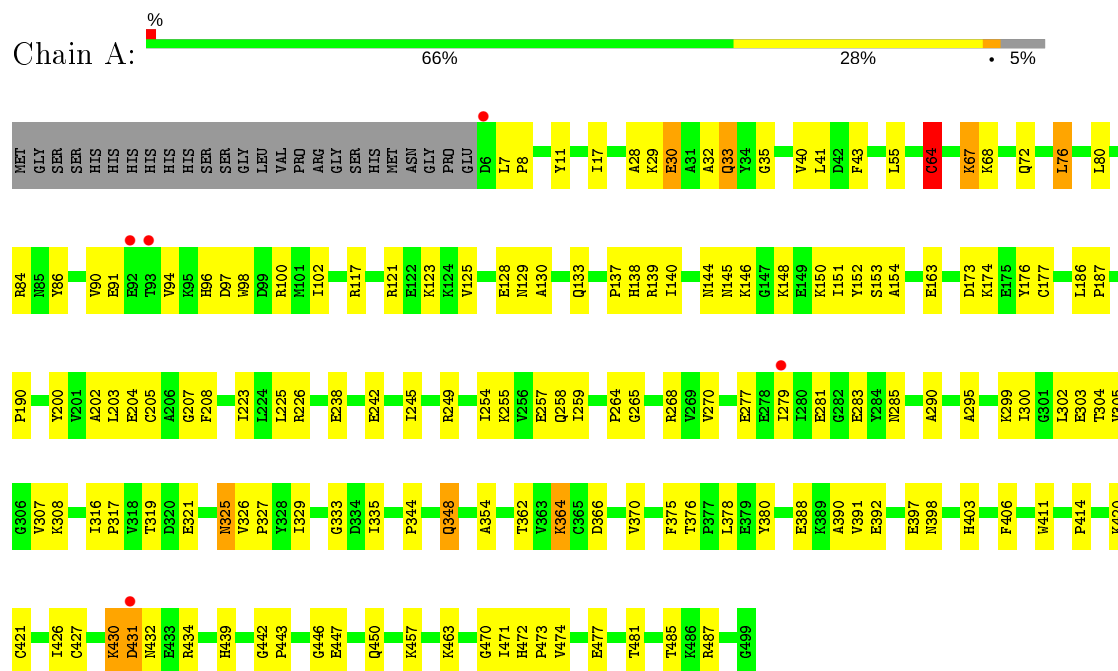
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	190	Total	O	0	0
			190	190		
5	B	202	Total	O	0	0
			202	202		
5	C	17	Total	O	0	0
			17	17		
5	D	16	Total	O	0	0
			16	16		

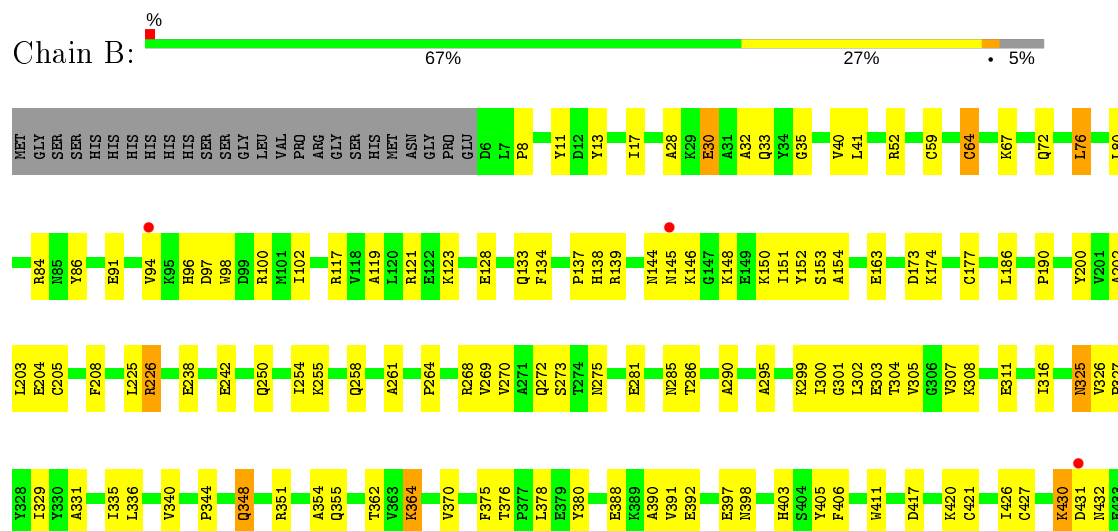
### 3 Residue-property plots

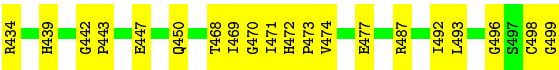
These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are 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: Thioredoxin reductase 1, cytoplasmic

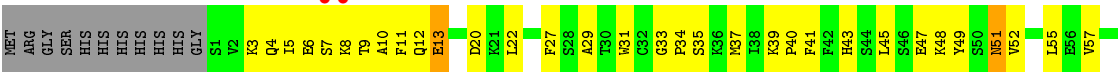


- Molecule 1: Thioredoxin reductase 1, cytoplasmic

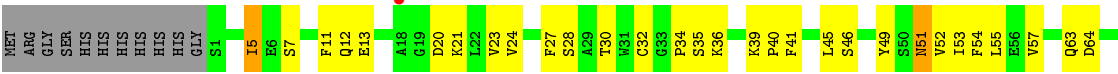




• Molecule 2: Thioredoxin



• Molecule 2: Thioredoxin



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	97.25Å 105.03Å 120.73Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	24.91 – 2.20 41.44 – 2.10	Depositor EDS
% Data completeness (in resolution range)	84.4 (24.91-2.20) 84.4 (41.44-2.10)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.10	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.17 (at 2.10Å)	Xtrriage
Refinement program	CNS	Depositor
R, $R_{free}$	0.237 , 0.283 0.234 , 0.275	Depositor DCC
$R_{free}$ test set	11816 reflections (5.96%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	29.3	Xtrriage
Anisotropy	0.472	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 55.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.29$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	9821	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	40.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 45.10 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 1.3871e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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: GOL, 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	0.35	0/3883	0.62	1/5256 (0.0%)
1	B	0.35	0/3883	0.62	1/5256 (0.0%)
2	C	0.37	0/834	0.51	0/1120
2	D	0.39	0/834	0.55	0/1120
All	All	0.36	0/9434	0.60	2/12752 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	64	CYS	CA-CB-SG	5.49	123.88	114.00
1	A	64	CYS	CA-CB-SG	5.13	123.24	114.00

There are no chirality outliers.

There are no planarity outliers.

### 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	3808	0	3814	164	0
1	B	3808	0	3814	141	0
2	C	819	0	806	43	0
2	D	819	0	806	42	0
3	A	53	0	31	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	53	0	31	0	0
4	A	24	0	16	1	0
4	B	6	0	4	1	0
4	D	6	0	4	0	0
5	A	190	0	0	9	0
5	B	202	0	0	11	0
5	C	17	0	0	1	0
5	D	16	0	0	1	0
All	All	9821	0	9326	354	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 19.

All (354) 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:84:ARG:HH12	1:A:90:VAL:HB	1.20	1.05
1:A:398:ASN:HD22	1:A:430:LYS:HG3	1.26	0.98
1:A:80:LEU:HD23	1:B:80:LEU:HD23	1.50	0.93
2:C:22:LEU:HD11	2:C:79:PHE:HB3	1.58	0.84
1:B:254:ILE:HG13	1:B:255:LYS:HG2	1.59	0.83
1:A:307:VAL:HA	1:A:325:ASN:HD21	1.44	0.83
2:D:23:VAL:HG22	2:D:53:ILE:HB	1.61	0.82
1:B:325:ASN:HD22	1:B:325:ASN:H	1.26	0.82
1:A:398:ASN:ND2	1:A:430:LYS:HG3	1.94	0.81
1:A:84:ARG:NH1	1:A:90:VAL:HB	1.96	0.80
1:B:91:GLU:HG3	1:B:94:VAL:HG22	1.63	0.80
1:B:307:VAL:HA	1:B:325:ASN:HD21	1.45	0.80
1:A:121:ARG:HD3	2:C:67:SER:HB2	1.65	0.79
1:A:325:ASN:HD22	1:A:325:ASN:H	1.28	0.78
2:C:41:PHE:O	2:C:45:LEU:HD13	1.85	0.77
1:B:145:ASN:OD1	1:B:146:LYS:HG3	1.87	0.74
1:A:471:ILE:H	1:B:450:GLN:HE22	1.33	0.74
1:A:145:ASN:OD1	1:A:146:LYS:HG3	1.88	0.73
1:B:311:GLU:HG3	5:B:623:HOH:O	1.88	0.73
1:B:380:TYR:OH	1:B:439:HIS:HD2	1.74	0.71
2:C:81:LYS:HB3	2:C:86:VAL:HG11	1.73	0.71
1:A:471:ILE:H	1:B:450:GLN:NE2	1.89	0.70
2:D:21:LYS:HZ2	2:D:21:LYS:HB3	1.57	0.70
1:B:250:GLN:NE2	1:B:275:ASN:HD21	1.90	0.69
1:A:254:ILE:HD11	1:A:270:VAL:HG12	1.73	0.69

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:380:TYR:OH	1:A:439:HIS:HD2	1.76	0.69
2:C:3:LYS:HB3	2:C:55:LEU:HD23	1.74	0.69
2:C:35:SER:HA	2:C:75:PRO:HG3	1.75	0.69
1:A:325:ASN:N	1:A:325:ASN:HD22	1.91	0.68
1:A:388:GLU:O	1:A:391:VAL:HG22	1.94	0.68
1:A:84:ARG:HG3	1:A:84:ARG:HH11	1.60	0.67
1:B:325:ASN:HD22	1:B:325:ASN:N	1.92	0.67
1:B:434:ARG:HH21	4:B:804:GOL:H11	1.57	0.67
1:A:430:LYS:O	1:A:431:ASP:HB3	1.95	0.67
1:B:117:ARG:O	1:B:121:ARG:HG3	1.94	0.67
1:B:117:ARG:NH2	2:D:63:GLN:HG2	2.10	0.66
1:B:388:GLU:O	1:B:391:VAL:HG22	1.96	0.66
2:D:35:SER:HA	2:D:75:PRO:HG3	1.78	0.66
2:C:84:GLN:O	2:C:86:VAL:HG13	1.96	0.66
1:A:450:GLN:HE22	1:B:471:ILE:H	1.43	0.66
1:A:344:PRO:HG3	1:B:472:HIS:HB2	1.77	0.65
2:D:21:LYS:NZ	2:D:21:LYS:HB3	2.10	0.65
1:B:250:GLN:CD	1:B:275:ASN:HD21	1.99	0.65
1:A:471:ILE:N	1:B:450:GLN:HE22	1.94	0.65
2:C:4:GLN:O	2:C:6:GLU:HG3	1.97	0.65
1:A:470:GLY:HA2	1:B:450:GLN:HE22	1.60	0.65
1:A:238:GLU:O	1:A:242:GLU:HG3	1.97	0.64
2:D:51:ASN:HD22	2:D:51:ASN:H	1.45	0.64
1:A:268:ARG:HH11	1:A:268:ARG:HB2	1.63	0.63
1:A:463:LYS:HG2	5:A:674:HOH:O	1.97	0.63
2:C:51:ASN:HD22	2:C:51:ASN:N	1.96	0.63
2:D:49:TYR:HB3	2:D:51:ASN:HD21	1.64	0.63
1:A:121:ARG:HH11	1:A:121:ARG:HB3	1.64	0.62
1:A:450:GLN:HE22	1:B:470:GLY:HA2	1.64	0.62
2:C:49:TYR:HD1	2:C:101:ILE:HG21	1.65	0.62
2:D:51:ASN:HD22	2:D:51:ASN:N	1.96	0.62
1:B:98:TRP:CZ2	1:B:102:ILE:HD11	2.35	0.61
2:C:51:ASN:ND2	2:C:52:VAL:HG23	2.16	0.61
1:A:117:ARG:HH21	2:C:63:GLN:HA	1.65	0.61
1:A:268:ARG:HD2	1:A:281:GLU:OE2	2.01	0.61
1:A:457:LYS:HG3	1:B:468:THR:OG1	2.01	0.61
2:D:81:LYS:NZ	2:D:82:LYS:HE3	2.15	0.61
1:A:431:ASP:HB3	4:A:804:GOL:H11	1.82	0.60
2:D:94:LYS:HE3	5:D:344:HOH:O	1.99	0.60
1:B:121:ARG:HG2	5:B:572:HOH:O	2.01	0.60
2:D:101:ILE:O	2:D:105:VAL:HG23	2.00	0.60

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:255:LYS:HG3	1:B:270:VAL:HB	1.82	0.60
1:B:426:ILE:HD12	1:B:426:ILE:N	2.17	0.60
1:A:33:GLN:HA	1:A:33:GLN:HE21	1.67	0.59
2:D:51:ASN:ND2	2:D:51:ASN:H	1.99	0.59
1:B:8:PRO:HG3	1:B:139:ARG:NH1	2.18	0.59
1:A:80:LEU:HD23	1:B:80:LEU:CD2	2.29	0.59
1:B:33:GLN:HE21	1:B:33:GLN:HA	1.67	0.59
1:A:303:GLU:HG2	1:A:304:THR:N	2.18	0.59
1:A:474:VAL:HG13	1:B:447:GLU:CD	2.23	0.59
1:A:348:GLN:HA	1:A:348:GLN:HE21	1.67	0.58
1:A:7:LEU:HD23	1:A:8:PRO:O	2.04	0.58
1:A:84:ARG:HH12	1:A:90:VAL:CB	2.05	0.58
1:A:96:HIS:HE1	1:B:86:TYR:O	1.85	0.57
2:C:81:LYS:HE3	2:C:82:LYS:HE3	1.85	0.57
1:A:139:ARG:HG2	1:A:139:ARG:HH11	1.68	0.57
1:A:426:ILE:HD12	1:A:426:ILE:N	2.19	0.57
1:A:254:ILE:HG12	1:A:270:VAL:O	2.05	0.57
1:B:305:VAL:HG13	1:B:307:VAL:HG23	1.86	0.57
2:D:34:PRO:HB2	2:D:75:PRO:HD3	1.87	0.57
1:B:139:ARG:HG2	1:B:139:ARG:HH11	1.68	0.57
1:A:133:GLN:C	1:A:140:ILE:HG13	2.25	0.57
1:B:348:GLN:HA	1:B:348:GLN:HE21	1.69	0.56
1:A:470:GLY:CA	1:B:450:GLN:HE22	2.18	0.56
1:A:205:CYS:HA	1:A:208:PHE:CE2	2.40	0.56
1:B:119:ALA:O	1:B:123:LYS:HG2	2.04	0.56
1:A:305:VAL:HG13	1:A:307:VAL:HG23	1.87	0.56
1:A:450:GLN:NE2	1:B:471:ILE:H	2.03	0.56
1:B:72:GLN:HG3	1:B:76:LEU:HD22	1.88	0.56
1:A:121:ARG:HH11	1:A:121:ARG:CB	2.19	0.55
1:B:340:VAL:HG21	1:B:370:VAL:HG21	1.87	0.55
2:C:39:LYS:HB3	2:C:40:PRO:HD3	1.88	0.55
1:B:268:ARG:HD2	1:B:281:GLU:OE2	2.07	0.55
1:B:303:GLU:HG2	1:B:304:THR:N	2.20	0.55
2:C:22:LEU:O	2:C:52:VAL:HG13	2.07	0.55
1:A:446:GLY:HA3	1:B:474:VAL:HG21	1.89	0.55
1:B:11:TYR:HA	1:B:153:SER:OG	2.07	0.55
1:B:411:TRP:CZ2	1:B:443:PRO:HG3	2.42	0.54
2:D:51:ASN:ND2	2:D:52:VAL:HG23	2.23	0.54
1:A:268:ARG:HH11	1:A:268:ARG:CB	2.20	0.54
2:D:27:PHE:CD1	2:D:71:VAL:HG21	2.43	0.54
1:B:258:GLN:NE2	1:B:261:ALA:HA	2.23	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:470:GLY:HA2	1:B:450:GLN:NE2	2.23	0.54
1:B:308:LYS:HG2	1:B:325:ASN:OD1	2.08	0.54
1:A:255:LYS:HG2	1:A:270:VAL:HB	1.88	0.53
1:A:316:ILE:HD12	1:A:335:ILE:HD12	1.90	0.53
1:A:72:GLN:HG3	1:A:76:LEU:HD22	1.91	0.53
1:A:80:LEU:CD2	1:B:80:LEU:HD23	2.31	0.53
1:B:41:LEU:HD23	1:B:128:GLU:HB3	1.91	0.53
2:C:52:VAL:HG21	2:C:105:VAL:HG21	1.91	0.53
2:D:39:LYS:HB3	2:D:40:PRO:HD3	1.91	0.52
1:A:450:GLN:HE22	1:B:470:GLY:CA	2.23	0.52
1:B:33:GLN:NE2	1:B:33:GLN:HA	2.24	0.52
1:A:33:GLN:HA	1:A:33:GLN:NE2	2.23	0.52
1:A:430:LYS:O	1:A:431:ASP:CB	2.56	0.52
1:A:308:LYS:HG2	1:A:325:ASN:OD1	2.09	0.52
1:B:255:LYS:CG	1:B:270:VAL:HB	2.40	0.52
1:B:316:ILE:HD12	1:B:335:ILE:HD12	1.91	0.52
1:A:67:LYS:HZ3	1:A:375:PHE:HD1	1.58	0.52
2:C:49:TYR:CD1	2:C:101:ILE:HG21	2.45	0.51
1:B:238:GLU:O	1:B:242:GLU:HG3	2.10	0.51
2:D:49:TYR:HB3	2:D:51:ASN:ND2	2.25	0.51
2:C:22:LEU:HD22	2:C:104:LEU:HB2	1.93	0.51
1:B:205:CYS:HA	1:B:208:PHE:CE2	2.44	0.51
1:A:17:ILE:HD12	1:A:28:ALA:HB2	1.93	0.51
1:A:447:GLU:CD	1:B:474:VAL:HG13	2.32	0.51
2:C:11:PHE:CD2	2:C:65:VAL:HG13	2.46	0.51
1:B:17:ILE:HD12	1:B:28:ALA:HB2	1.92	0.50
1:B:325:ASN:H	1:B:325:ASN:ND2	2.03	0.50
2:D:41:PHE:O	2:D:45:LEU:HB2	2.10	0.50
1:B:226:ARG:HG3	1:B:226:ARG:NH1	2.26	0.50
1:A:370:VAL:HG13	1:B:469:ILE:HB	1.92	0.50
2:C:7:SER:HB3	2:C:10:ALA:CB	2.42	0.50
1:A:117:ARG:HH11	1:A:117:ARG:HG3	1.77	0.50
1:A:145:ASN:HB2	5:A:677:HOH:O	2.12	0.50
1:B:250:GLN:CD	1:B:275:ASN:ND2	2.64	0.50
1:B:226:ARG:HH11	1:B:226:ARG:CG	2.25	0.50
1:A:472:HIS:HB2	1:B:344:PRO:HG3	1.92	0.50
2:D:81:LYS:HZ2	2:D:82:LYS:HE3	1.74	0.50
1:A:98:TRP:CZ2	1:A:102:ILE:HD11	2.47	0.50
1:A:123:LYS:HB2	1:A:125:VAL:HG23	1.93	0.50
2:D:51:ASN:ND2	2:D:51:ASN:N	2.59	0.50
1:A:474:VAL:O	1:A:477:GLU:HG2	2.12	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:474:VAL:O	1:B:477:GLU:HG2	2.12	0.50
2:C:81:LYS:HB2	2:C:86:VAL:HG21	1.92	0.50
2:D:84:GLN:NE2	2:D:85:LYS:H	2.09	0.50
1:B:91:GLU:HG3	1:B:94:VAL:CG2	2.38	0.50
1:B:264:PRO:HB2	1:B:285:ASN:HB3	1.94	0.49
2:D:5:ILE:CG1	2:D:57:VAL:HG22	2.41	0.49
1:B:84:ARG:HB3	1:B:84:ARG:NH1	2.28	0.49
1:A:257:GLU:OE1	1:A:268:ARG:NH2	2.45	0.49
1:A:255:LYS:CG	1:A:270:VAL:HB	2.42	0.49
1:A:406:PHE:CZ	1:A:421:CYS:HB3	2.47	0.49
1:A:325:ASN:ND2	1:A:325:ASN:H	2.05	0.49
1:B:137:PRO:O	1:B:139:ARG:HG3	2.13	0.49
1:A:97:ASP:CG	1:A:100:ARG:HG3	2.32	0.49
2:C:8:LYS:HB3	2:C:64:ASP:HB2	1.95	0.49
1:A:144:ASN:ND2	1:A:148:LYS:HB3	2.27	0.49
1:A:8:PRO:HG2	1:A:153:SER:CB	2.41	0.49
1:A:121:ARG:CB	1:A:121:ARG:NH1	2.76	0.49
1:A:283:GLU:N	5:A:686:HOH:O	2.40	0.48
1:A:207:GLY:HA2	1:A:245:ILE:HD11	1.95	0.48
1:A:254:ILE:HD11	1:A:270:VAL:CG1	2.41	0.48
1:B:406:PHE:CZ	1:B:421:CYS:HB3	2.48	0.48
1:A:150:LYS:HD3	1:A:152:TYR:OH	2.14	0.48
1:A:137:PRO:O	1:A:139:ARG:HG3	2.13	0.48
1:A:30:GLU:O	1:A:33:GLN:HB3	2.14	0.48
1:B:258:GLN:HE21	1:B:261:ALA:HA	1.78	0.48
1:B:299:LYS:NZ	1:B:299:LYS:HB3	2.29	0.48
1:A:450:GLN:HE22	1:B:471:ILE:N	2.09	0.48
1:B:493:LEU:CD1	1:B:493:LEU:N	2.76	0.48
1:A:203:LEU:HD12	1:A:225:LEU:HD21	1.96	0.48
1:B:203:LEU:HD12	1:B:225:LEU:HD21	1.94	0.48
1:A:117:ARG:NE	2:C:63:GLN:HB3	2.29	0.48
1:A:30:GLU:HB3	1:A:354:ALA:HB3	1.96	0.48
1:B:286:THR:HG23	5:B:543:HOH:O	2.14	0.48
1:B:13:TYR:O	1:B:154:ALA:HA	2.13	0.48
1:A:268:ARG:CB	1:A:268:ARG:NH1	2.77	0.47
1:A:133:GLN:HG3	1:A:300:ILE:C	2.34	0.47
1:A:11:TYR:HE1	5:A:661:HOH:O	1.97	0.47
1:B:272:GLN:HG2	1:B:273:SER:N	2.28	0.47
1:A:139:ARG:HG2	1:A:139:ARG:NH1	2.29	0.47
1:A:299:LYS:HB3	1:A:299:LYS:NZ	2.28	0.47
1:A:431:ASP:O	1:A:432:ASN:OD1	2.32	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:30:GLU:OE1	1:B:30:GLU:HA	2.14	0.47
1:B:121:ARG:HB3	1:B:121:ARG:HH11	1.80	0.47
2:C:69:CYS:HB3	2:C:78:GLN:HE22	1.80	0.47
1:A:450:GLN:NE2	1:B:477:GLU:HA	2.29	0.47
1:B:59:CYS:HB3	5:B:653:HOH:O	2.15	0.47
1:B:186:LEU:CD2	1:B:190:PRO:HG3	2.45	0.47
1:B:305:VAL:HG21	1:B:329:ILE:HD11	1.96	0.47
2:C:7:SER:HB3	2:C:10:ALA:HB2	1.96	0.47
1:A:173:ASP:O	1:A:177:CYS:HB2	2.15	0.47
1:A:30:GLU:OE1	1:A:30:GLU:HA	2.14	0.46
1:A:7:LEU:HD23	1:A:7:LEU:C	2.36	0.46
1:B:30:GLU:O	1:B:33:GLN:HB3	2.15	0.46
2:C:12:GLN:HA	2:C:12:GLN:NE2	2.30	0.46
1:A:86:TYR:O	1:B:96:HIS:HE1	1.98	0.46
1:B:144:ASN:ND2	1:B:148:LYS:HB3	2.30	0.46
1:B:173:ASP:O	1:B:177:CYS:HB2	2.15	0.46
2:C:43:HIS:O	2:C:47:GLU:HG2	2.15	0.46
1:A:138:HIS:O	1:A:153:SER:HA	2.16	0.46
1:A:305:VAL:HG21	1:A:329:ILE:HD11	1.97	0.46
1:B:138:HIS:O	1:B:153:SER:HA	2.15	0.46
1:B:30:GLU:HB3	1:B:354:ALA:HB3	1.97	0.46
2:C:72:LYS:HG2	5:C:114:HOH:O	2.15	0.46
1:A:32:ALA:O	1:A:35:GLY:N	2.48	0.46
1:A:362:THR:O	1:A:364:LYS:HD2	2.15	0.46
1:B:139:ARG:HG2	1:B:139:ARG:NH1	2.29	0.46
1:A:64:CYS:SG	1:B:472:HIS:HD2	2.38	0.46
1:A:121:ARG:HE	2:C:67:SER:HA	1.80	0.46
1:B:133:GLN:NE2	5:B:530:HOH:O	2.35	0.46
2:C:29:ALA:HB1	2:C:31:TRP:CE2	2.50	0.46
2:C:81:LYS:HB3	2:C:86:VAL:CG1	2.44	0.46
1:A:176:TYR:CE1	1:A:258:GLN:HB2	2.51	0.45
1:A:326:VAL:HA	1:A:327:PRO:HD3	1.82	0.45
1:A:411:TRP:C	1:A:414:PRO:HD2	2.37	0.45
1:B:150:LYS:HD3	1:B:152:TYR:OH	2.16	0.45
2:C:4:GLN:HA	2:C:4:GLN:NE2	2.31	0.45
1:A:117:ARG:HG3	1:A:117:ARG:NH1	2.32	0.45
1:A:173:ASP:OD1	1:A:174:LYS:N	2.49	0.45
1:A:186:LEU:CD2	1:A:190:PRO:HG3	2.46	0.45
1:A:487:ARG:HH11	1:A:487:ARG:HG3	1.81	0.45
2:D:79:PHE:HB2	2:D:87:GLY:HA3	1.99	0.45
1:A:325:ASN:ND2	1:A:325:ASN:N	2.62	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:485:THR:HB	5:A:508:HOH:O	2.16	0.45
2:C:22:LEU:HD23	2:C:105:VAL:CG2	2.47	0.45
1:B:391:VAL:HG23	1:B:392:GLU:N	2.31	0.45
1:A:411:TRP:CZ2	1:A:443:PRO:HG3	2.52	0.45
1:A:117:ARG:NH2	2:C:63:GLN:HG2	2.30	0.45
1:A:55:LEU:HD23	1:A:117:ARG:HG2	1.97	0.45
1:B:173:ASP:OD1	1:B:174:LYS:N	2.50	0.45
1:A:41:LEU:HD23	1:A:128:GLU:HB3	1.99	0.45
1:A:84:ARG:HG3	1:A:84:ARG:NH1	2.29	0.45
1:B:97:ASP:CG	1:B:100:ARG:HG3	2.37	0.45
2:D:21:LYS:NZ	2:D:51:ASN:O	2.46	0.45
2:D:5:ILE:C	2:D:5:ILE:HD12	2.37	0.45
1:A:151:ILE:HD12	1:A:151:ILE:N	2.32	0.44
1:A:249:ARG:HB3	5:A:675:HOH:O	2.16	0.44
1:A:67:LYS:C	1:A:67:LYS:HD2	2.37	0.44
1:B:32:ALA:O	1:B:35:GLY:N	2.49	0.44
1:B:139:ARG:NH2	1:B:151:ILE:HG21	2.32	0.44
1:B:151:ILE:HG22	5:B:552:HOH:O	2.17	0.44
1:A:139:ARG:NH2	1:A:151:ILE:HG21	2.33	0.44
1:A:11:TYR:HA	1:A:153:SER:OG	2.18	0.44
1:B:362:THR:O	1:B:364:LYS:HD2	2.16	0.44
1:A:163:GLU:HG2	1:A:295:ALA:HA	1.99	0.44
2:D:24:VAL:HG22	2:D:79:PHE:CD2	2.53	0.44
1:A:265:GLY:O	1:A:285:ASN:HA	2.17	0.44
1:A:390:ALA:CB	1:A:426:ILE:HG21	2.48	0.44
1:B:269:VAL:O	1:B:281:GLU:HA	2.16	0.44
1:B:398:ASN:HD22	1:B:430:LYS:HG3	1.82	0.44
1:A:450:GLN:NE2	1:B:470:GLY:HA2	2.32	0.44
1:A:450:GLN:HE21	1:B:477:GLU:HA	1.82	0.44
1:B:487:ARG:HG3	1:B:487:ARG:HH11	1.82	0.44
2:C:97:LEU:O	2:C:101:ILE:HG13	2.18	0.44
2:D:30:THR:O	2:D:36:LYS:HD3	2.18	0.44
1:A:391:VAL:HG23	1:A:392:GLU:N	2.31	0.44
2:C:22:LEU:HD23	2:C:105:VAL:HG23	1.99	0.44
1:B:151:ILE:N	1:B:151:ILE:HD12	2.32	0.43
1:B:226:ARG:CG	1:B:226:ARG:NH1	2.80	0.43
1:A:397:GLU:H	1:A:397:GLU:CD	2.22	0.43
1:B:325:ASN:N	1:B:325:ASN:ND2	2.63	0.43
1:A:366:ASP:HB3	5:A:541:HOH:O	2.17	0.43
1:B:431:ASP:OD1	1:B:432:ASN:ND2	2.52	0.43
1:A:11:TYR:HB3	1:A:154:ALA:HA	2.01	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:43:PHE:HA	5:A:514:HOH:O	2.18	0.43
2:D:93:ASN:OD1	2:D:96:LYS:N	2.41	0.43
1:A:40:VAL:HG23	1:A:40:VAL:O	2.18	0.43
1:A:29:LYS:HD2	1:A:123:LYS:NZ	2.33	0.43
1:B:117:ARG:HB3	5:B:664:HOH:O	2.18	0.43
1:B:405:TYR:CD1	1:B:492:ILE:HG13	2.53	0.43
1:B:498:CYS:SG	2:C:34:PRO:HD2	2.59	0.43
2:D:5:ILE:HG13	2:D:57:VAL:HG22	2.01	0.43
1:B:40:VAL:HG23	1:B:40:VAL:O	2.18	0.43
2:C:48:LYS:HE2	2:C:49:TYR:HE2	1.82	0.43
1:B:378:LEU:HD12	1:B:378:LEU:HA	1.84	0.43
1:B:390:ALA:CB	1:B:426:ILE:HG21	2.48	0.43
1:B:67:LYS:HZ3	1:B:375:PHE:HD1	1.64	0.43
2:D:103:GLU:HG2	2:D:103:GLU:O	2.17	0.43
2:D:5:ILE:HG21	2:D:55:LEU:HD13	2.00	0.43
1:B:134:PHE:HB2	1:B:301:GLY:O	2.18	0.43
1:B:67:LYS:C	1:B:67:LYS:HD2	2.39	0.43
1:B:326:VAL:HA	1:B:327:PRO:HD3	1.82	0.42
2:C:27:PHE:CD1	2:C:57:VAL:HB	2.53	0.42
1:A:277:GLU:O	1:A:279:ILE:HG13	2.19	0.42
1:B:427:CYS:HA	1:B:434:ARG:O	2.20	0.42
1:A:378:LEU:HD11	1:A:442:GLY:HA2	2.00	0.42
1:A:90:VAL:HG12	1:A:91:GLU:N	2.35	0.42
1:A:420:LYS:HD3	1:A:420:LYS:HA	1.88	0.42
1:B:397:GLU:CD	1:B:397:GLU:H	2.22	0.42
2:C:4:GLN:HA	2:C:4:GLN:HE21	1.85	0.42
2:C:9:THR:O	2:C:13:GLU:HB2	2.20	0.42
1:B:202:ALA:HB2	1:B:290:ALA:HB3	2.01	0.42
1:A:202:ALA:HB2	1:A:290:ALA:HB3	2.01	0.42
1:A:398:ASN:ND2	1:A:430:LYS:CG	2.75	0.42
1:B:200:TYR:O	1:B:204:GLU:HG3	2.20	0.42
1:B:378:LEU:HD11	1:B:442:GLY:HA2	2.00	0.42
1:A:223:ILE:HD11	1:A:226:ARG:HG3	2.00	0.41
1:A:427:CYS:HA	1:A:434:ARG:O	2.20	0.41
1:A:431:ASP:OD2	1:A:432:ASN:ND2	2.52	0.41
1:A:333:GLY:HA3	3:A:600:FAD:O2P	2.19	0.41
2:D:46:SER:HA	2:D:54:PHE:CZ	2.55	0.41
1:A:144:ASN:HD21	1:A:148:LYS:HB3	1.84	0.41
1:A:200:TYR:O	1:A:204:GLU:HG3	2.20	0.41
1:B:91:GLU:CG	1:B:94:VAL:HG22	2.43	0.41
2:D:28:SER:HB2	2:D:35:SER:OG	2.20	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:128:GLU:O	1:A:130:ALA:N	2.52	0.41
1:A:144:ASN:HD21	1:A:148:LYS:CB	2.33	0.41
1:A:94:VAL:HA	5:A:628:HOH:O	2.20	0.41
2:C:33:GLY:O	2:C:37:MET:HG2	2.20	0.41
1:A:226:ARG:HH11	1:A:226:ARG:HB2	1.86	0.41
1:A:259:ILE:HD12	1:A:283:GLU:HG3	2.02	0.41
1:A:33:GLN:HE21	1:A:33:GLN:CA	2.28	0.41
1:B:163:GLU:HG2	1:B:295:ALA:HA	2.03	0.41
1:B:417:ASP:HB3	1:B:420:LYS:HG3	2.03	0.41
2:D:80:PHE:HA	2:D:84:GLN:O	2.21	0.41
1:A:302:LEU:O	1:A:305:VAL:HG12	2.21	0.41
1:B:186:LEU:HD23	1:B:190:PRO:HG3	2.02	0.41
1:B:268:ARG:HH11	1:B:268:ARG:HB2	1.84	0.41
1:A:67:LYS:NZ	1:A:375:PHE:CD1	2.88	0.41
1:A:97:ASP:OD1	1:A:100:ARG:HG3	2.21	0.41
1:B:493:LEU:N	1:B:493:LEU:HD12	2.35	0.41
1:B:300:ILE:HG13	1:B:302:LEU:HG	2.03	0.41
1:B:67:LYS:NZ	1:B:375:PHE:CD1	2.89	0.41
1:B:487:ARG:HG3	5:B:689:HOH:O	2.20	0.41
1:A:316:ILE:HA	1:A:317:PRO:HD3	1.90	0.41
1:A:8:PRO:HG2	1:A:153:SER:HB2	2.02	0.41
1:B:391:VAL:CG2	1:B:392:GLU:N	2.84	0.41
2:C:8:LYS:HB3	2:C:64:ASP:CB	2.51	0.41
2:D:98:GLU:O	2:D:102:ASN:ND2	2.54	0.41
1:A:186:LEU:HA	1:A:187:PRO:HD3	1.70	0.41
2:D:24:VAL:HG21	2:D:101:ILE:HG12	2.03	0.41
2:D:5:ILE:HD13	2:D:11:PHE:HB2	2.02	0.41
1:A:259:ILE:HG12	1:A:268:ARG:NH1	2.35	0.40
1:B:355:GLN:NE2	5:B:676:HOH:O	2.53	0.40
1:A:344:PRO:CG	1:B:472:HIS:HB2	2.49	0.40
2:D:46:SER:HA	2:D:54:PHE:CE1	2.56	0.40
1:A:98:TRP:O	1:A:102:ILE:HG12	2.21	0.40
2:D:32:CYS:SG	2:D:34:PRO:HD2	2.62	0.40
1:A:481:THR:HG21	1:B:351:ARG:HH12	1.86	0.40
1:B:496:GLY:H	1:B:499:GLY:C	2.24	0.40
2:D:12:GLN:NE2	2:D:12:GLN:HA	2.37	0.40
2:D:21:LYS:HZ2	2:D:21:LYS:CB	2.31	0.40
1:A:68:LYS:HE2	5:B:558:HOH:O	2.22	0.40
1:B:370:VAL:HG23	5:B:668:HOH:O	2.21	0.40
2:D:70:GLU:OE2	2:D:72:LYS:HE3	2.22	0.40
1:A:319:THR:C	1:A:321:GLU:H	2.25	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:331:ALA:O	1:B:336:LEU:HD21	2.21	0.40

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	492/519 (95%)	462 (94%)	25 (5%)	5 (1%)	15	14
1	B	492/519 (95%)	464 (94%)	26 (5%)	2 (0%)	34	37
2	C	103/116 (89%)	90 (87%)	12 (12%)	1 (1%)	15	14
2	D	103/116 (89%)	100 (97%)	3 (3%)	0	100	100
All	All	1190/1270 (94%)	1116 (94%)	66 (6%)	8 (1%)	22	22

All (8) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	431	ASP
2	C	65	VAL
1	A	129	ASN
1	B	430	LYS
1	A	33	GLN
1	A	430	LYS
1	B	473	PRO
1	A	473	PRO

### 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	405/426 (95%)	395 (98%)	10 (2%)	47	60
1	B	405/426 (95%)	395 (98%)	10 (2%)	47	60
2	C	92/101 (91%)	88 (96%)	4 (4%)	29	36
2	D	92/101 (91%)	85 (92%)	7 (8%)	13	14
All	All	994/1054 (94%)	963 (97%)	31 (3%)	40	51

All (31) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	30	GLU
1	A	64	CYS
1	A	67	LYS
1	A	76	LEU
1	A	264	PRO
1	A	325	ASN
1	A	348	GLN
1	A	364	LYS
1	A	376	THR
1	A	403	HIS
1	B	30	GLU
1	B	52	ARG
1	B	64	CYS
1	B	76	LEU
1	B	226	ARG
1	B	325	ASN
1	B	348	GLN
1	B	364	LYS
1	B	376	THR
1	B	403	HIS
2	C	5	ILE
2	C	13	GLU
2	C	20	ASP
2	C	51	ASN
2	D	5	ILE
2	D	7	SER
2	D	13	GLU
2	D	20	ASP
2	D	51	ASN
2	D	64	ASP

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Mol	Chain	Res	Type
2	D	67	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (38) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	33	GLN
1	A	96	HIS
1	A	107	ASN
1	A	113	ASN
1	A	138	HIS
1	A	325	ASN
1	A	348	GLN
1	A	355	GLN
1	A	398	ASN
1	A	432	ASN
1	A	439	HIS
1	A	450	GLN
1	A	494	GLN
1	B	33	GLN
1	B	96	HIS
1	B	107	ASN
1	B	113	ASN
1	B	129	ASN
1	B	138	HIS
1	B	250	GLN
1	B	258	GLN
1	B	275	ASN
1	B	325	ASN
1	B	348	GLN
1	B	355	GLN
1	B	398	ASN
1	B	439	HIS
1	B	450	GLN
1	B	472	HIS
2	C	4	GLN
2	C	12	GLN
2	C	51	ASN
2	C	63	GLN
2	D	4	GLN
2	D	12	GLN
2	D	51	ASN
2	D	84	GLN

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Mol	Chain	Res	Type
2	D	102	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 ⓘ

8 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
4	GOL	A	803	-	5,5,5	4.58	5 (100%)	5,5,5	5.78	3 (60%)
3	FAD	B	600	-	51,58,58	2.04	9 (17%)	60,89,89	1.93	3 (5%)
4	GOL	A	802	-	5,5,5	4.52	5 (100%)	5,5,5	5.79	3 (60%)
3	FAD	A	600	-	51,58,58	2.10	10 (19%)	60,89,89	1.95	4 (6%)
4	GOL	A	801	-	5,5,5	4.50	5 (100%)	5,5,5	5.81	3 (60%)
4	GOL	D	803	-	5,5,5	4.59	5 (100%)	5,5,5	5.75	3 (60%)
4	GOL	B	804	-	5,5,5	4.57	5 (100%)	5,5,5	5.77	3 (60%)
4	GOL	A	804	-	5,5,5	4.55	5 (100%)	5,5,5	5.77	3 (60%)

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
4	GOL	A	803	-	-	2/4/4/4	-
3	FAD	B	600	-	-	4/30/50/50	0/6/6/6
4	GOL	A	802	-	-	3/4/4/4	-
3	FAD	A	600	-	-	5/30/50/50	0/6/6/6
4	GOL	A	801	-	-	2/4/4/4	-
4	GOL	D	803	-	-	2/4/4/4	-
4	GOL	B	804	-	-	3/4/4/4	-
4	GOL	A	804	-	-	2/4/4/4	-

All (49) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	803	GOL	C3-C2	-7.50	1.20	1.51
4	D	803	GOL	C3-C2	-7.50	1.20	1.51
4	B	804	GOL	C3-C2	-7.45	1.21	1.51
4	A	804	GOL	C3-C2	-7.45	1.21	1.51
4	A	802	GOL	C3-C2	-7.41	1.21	1.51
4	A	801	GOL	C3-C2	-7.39	1.21	1.51
3	B	600	FAD	C4X-N5	6.35	1.42	1.33
3	B	600	FAD	C4X-C10	6.16	1.45	1.38
3	A	600	FAD	C4X-C10	6.16	1.45	1.38
3	A	600	FAD	C4X-N5	6.10	1.42	1.33
3	A	600	FAD	C9A-N10	5.82	1.46	1.38
3	B	600	FAD	C9A-N10	4.79	1.45	1.38
3	A	600	FAD	C10-N1	4.78	1.39	1.33
4	A	801	GOL	O1-C1	4.65	1.62	1.42
3	B	600	FAD	C10-N1	4.60	1.39	1.33
3	B	600	FAD	C4-N3	4.59	1.41	1.33
4	A	803	GOL	O1-C1	4.58	1.61	1.42
3	A	600	FAD	C4-N3	4.50	1.40	1.33
4	B	804	GOL	O1-C1	4.49	1.61	1.42
4	A	802	GOL	O1-C1	4.45	1.61	1.42
4	D	803	GOL	O1-C1	4.44	1.61	1.42
4	A	804	GOL	O1-C1	4.27	1.60	1.42
3	B	600	FAD	C4A-N3A	4.20	1.41	1.35
3	A	600	FAD	C4A-N3A	4.11	1.41	1.35
4	A	804	GOL	O3-C3	3.48	1.57	1.42
4	A	802	GOL	O3-C3	3.44	1.56	1.42
4	D	803	GOL	O3-C3	3.44	1.56	1.42

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	803	GOL	O3-C3	3.38	1.56	1.42
4	B	804	GOL	O3-C3	3.36	1.56	1.42
3	B	600	FAD	C5X-N5	3.32	1.40	1.35
4	A	801	GOL	O3-C3	3.27	1.56	1.42
4	D	803	GOL	O2-C2	-3.06	1.34	1.43
4	A	804	GOL	C1-C2	-3.05	1.39	1.51
4	B	804	GOL	O2-C2	-3.01	1.34	1.43
3	A	600	FAD	C9-C8	2.98	1.45	1.37
4	A	804	GOL	O2-C2	-2.91	1.34	1.43
4	B	804	GOL	C1-C2	-2.91	1.39	1.51
4	D	803	GOL	C1-C2	-2.90	1.39	1.51
4	A	802	GOL	C1-C2	-2.87	1.39	1.51
4	A	803	GOL	O2-C2	-2.86	1.34	1.43
4	A	803	GOL	C1-C2	-2.84	1.40	1.51
3	B	600	FAD	C9-C8	2.76	1.44	1.37
4	A	802	GOL	O2-C2	-2.75	1.35	1.43
4	A	801	GOL	C1-C2	-2.74	1.40	1.51
4	A	801	GOL	O2-C2	-2.61	1.35	1.43
3	B	600	FAD	C2A-N3A	2.31	1.35	1.32
3	A	600	FAD	C5X-N5	2.24	1.39	1.35
3	A	600	FAD	C9A-C5X	2.15	1.46	1.42
3	A	600	FAD	O4B-C1B	2.12	1.44	1.41

All (25) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	600	FAD	C4-N3-C2	11.59	124.92	115.14
3	B	600	FAD	C4-N3-C2	11.58	124.92	115.14
4	A	801	GOL	O3-C3-C2	10.59	160.96	110.20
4	A	803	GOL	O3-C3-C2	10.55	160.78	110.20
4	A	802	GOL	O3-C3-C2	10.53	160.69	110.20
4	B	804	GOL	O3-C3-C2	10.52	160.64	110.20
4	A	804	GOL	O3-C3-C2	10.43	160.21	110.20
4	D	803	GOL	O3-C3-C2	10.43	160.19	110.20
4	A	804	GOL	O2-C2-C3	6.88	139.45	109.12
4	D	803	GOL	O2-C2-C3	6.77	138.96	109.12
4	A	802	GOL	O2-C2-C3	6.72	138.71	109.12
4	A	801	GOL	O2-C2-C3	6.69	138.61	109.12
4	B	804	GOL	O2-C2-C3	6.69	138.58	109.12
4	A	803	GOL	O2-C2-C3	6.69	138.57	109.12
3	B	600	FAD	C4X-C4-N3	-5.84	115.44	123.43
3	A	600	FAD	C4X-C4-N3	-5.70	115.64	123.43

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	600	FAD	C1'-N10-C9A	3.70	121.20	118.29
4	A	801	GOL	O1-C1-C2	3.31	126.07	110.20
4	A	802	GOL	O1-C1-C2	3.29	126.00	110.20
4	D	803	GOL	O1-C1-C2	3.22	125.66	110.20
4	B	804	GOL	O1-C1-C2	3.21	125.59	110.20
4	A	803	GOL	O1-C1-C2	3.21	125.57	110.20
4	A	804	GOL	O1-C1-C2	3.10	125.08	110.20
3	B	600	FAD	C1'-N10-C9A	2.50	120.26	118.29
3	A	600	FAD	C9A-N10-C10	-2.03	119.25	121.91

There are no chirality outliers.

All (23) torsion outliers are listed below:

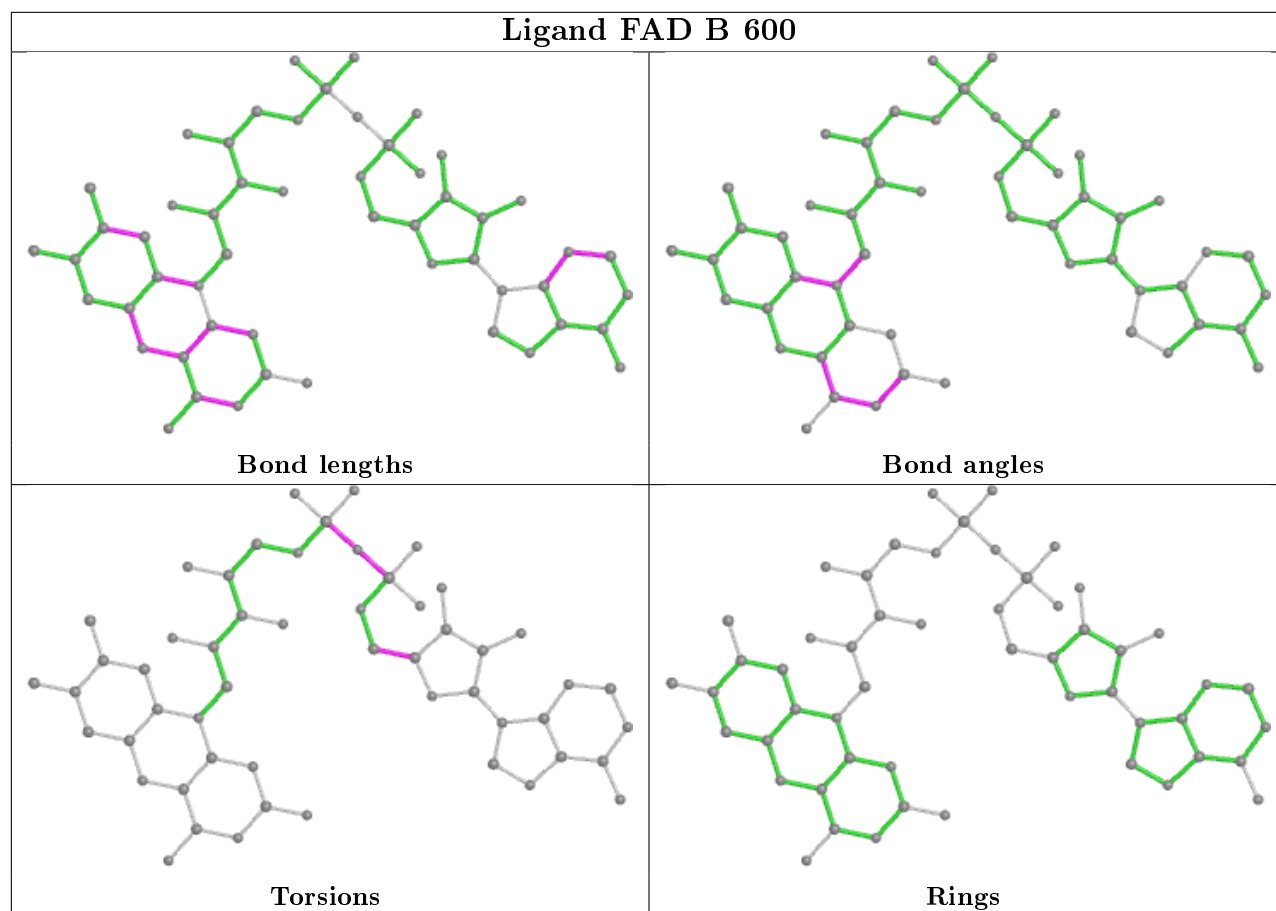
Mol	Chain	Res	Type	Atoms
4	A	803	GOL	O1-C1-C2-C3
4	A	803	GOL	C1-C2-C3-O3
4	A	802	GOL	C1-C2-C3-O3
4	A	801	GOL	C1-C2-C3-O3
4	D	803	GOL	O1-C1-C2-C3
4	D	803	GOL	C1-C2-C3-O3
4	B	804	GOL	C1-C2-C3-O3
4	A	804	GOL	C1-C2-C3-O3
3	A	600	FAD	O4B-C4B-C5B-O5B
4	B	804	GOL	O1-C1-C2-C3
4	A	804	GOL	O1-C1-C2-C3
4	A	801	GOL	O1-C1-C2-O2
4	B	804	GOL	O1-C1-C2-O2
4	A	802	GOL	O1-C1-C2-O2
3	B	600	FAD	PA-O3P-P-O5'
3	A	600	FAD	PA-O3P-P-O5'
3	B	600	FAD	P-O3P-PA-O1A
3	A	600	FAD	P-O3P-PA-O1A
3	B	600	FAD	O4B-C4B-C5B-O5B
3	A	600	FAD	C3B-C4B-C5B-O5B
4	A	802	GOL	O1-C1-C2-C3
3	B	600	FAD	P-O3P-PA-O2A
3	A	600	FAD	P-O3P-PA-O2A

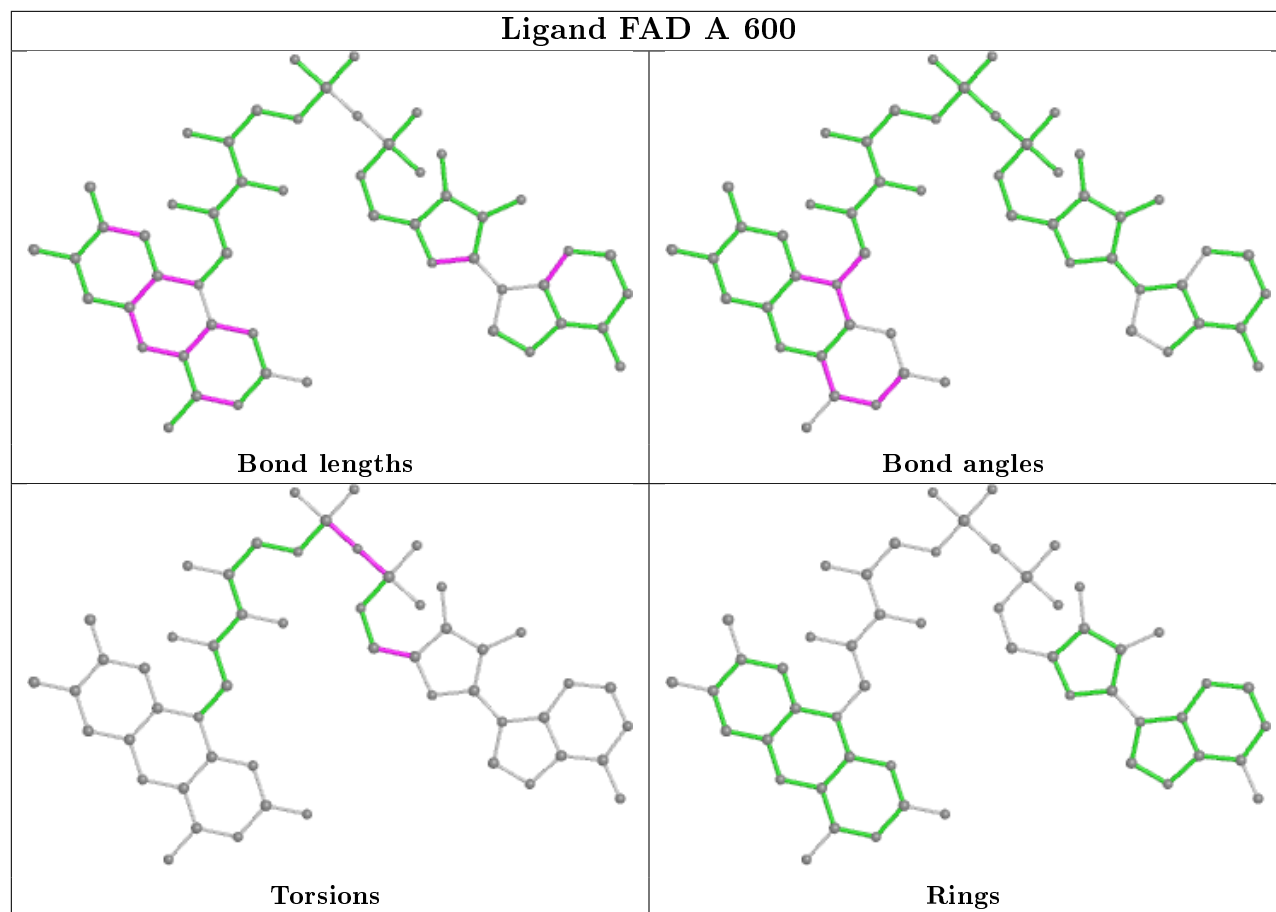
There are no ring outliers.

3 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	600	FAD	1	0
4	B	804	GOL	1	0
4	A	804	GOL	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.





## 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	494/519 (95%)	-0.19	5 (1%) 82 81	22, 37, 57, 88	0
1	B	494/519 (95%)	-0.22	3 (0%) 89 88	21, 35, 58, 80	0
2	C	105/116 (90%)	0.32	8 (7%) 13 12	30, 54, 68, 74	0
2	D	105/116 (90%)	-0.05	4 (3%) 40 38	29, 42, 63, 69	0
All	All	1198/1270 (94%)	-0.15	20 (1%) 70 68	21, 38, 63, 88	0

All (20) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	C	7	SER	4.1
2	D	86	VAL	4.0
1	B	431	ASP	3.8
2	C	66	ALA	3.0
2	C	105	VAL	2.9
2	C	8	LYS	2.6
1	A	6	ASP	2.6
2	C	67	SER	2.6
1	B	94	VAL	2.5
1	A	431	ASP	2.5
2	C	83	GLY	2.4
1	A	93	THR	2.4
1	A	92	GLU	2.4
1	B	145	ASN	2.3
2	D	18	ALA	2.3
2	D	84	GLN	2.2
2	C	86	VAL	2.1
1	A	279	ILE	2.1
2	D	105	VAL	2.1
2	C	72	LYS	2.1

## 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](#)

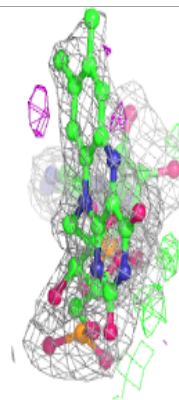
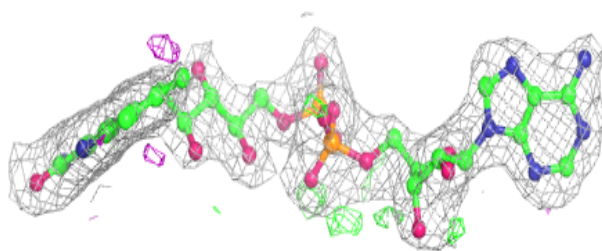
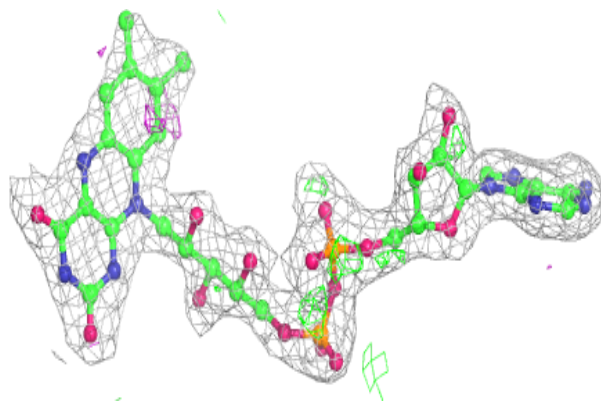
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 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
4	GOL	A	801	6/6	0.71	0.16	60,61,62,62	0
4	GOL	B	804	6/6	0.80	0.26	59,65,66,68	0
4	GOL	A	802	6/6	0.86	0.21	57,60,61,62	0
4	GOL	A	804	6/6	0.87	0.23	52,54,54,55	0
4	GOL	A	803	6/6	0.89	0.18	55,55,56,58	0
4	GOL	D	803	6/6	0.89	0.26	68,69,70,70	0
3	FAD	A	600	53/53	0.95	0.12	32,39,42,42	0
3	FAD	B	600	53/53	0.96	0.13	23,29,32,34	0

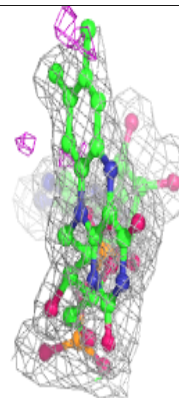
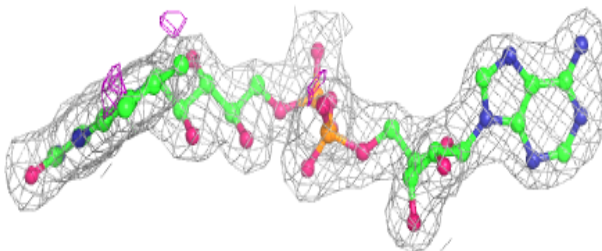
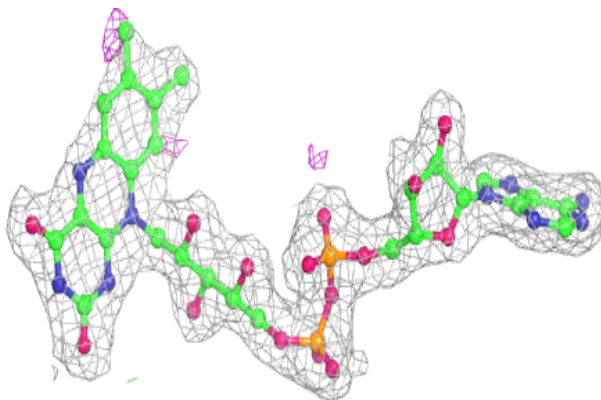
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

**Electron density around FAD A 600:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)

**Electron density around FAD B 600:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



## 6.5 Other polymers [i](#)

There are no such residues in this entry.