



# Full wwPDB X-ray Structure Validation Report ⓘ

Sep 22, 2016 – 03:41 PM EDT

PDB ID : 5FS7  
Title : Crystal structure of the G262S mutant of human apoptosis inducing factor  
Authors : Sevrioukova, I.  
Deposited on : 2015-12-30  
Resolution : 1.85 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

<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 : 1.7.1 (RC1), CSD as537be (2016)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20027939  
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) : rb-20027939

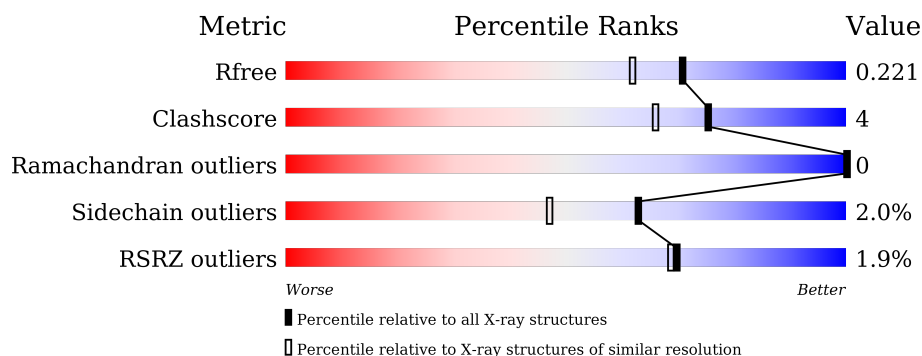
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.85 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	1745 (1.86-1.86)
Clashscore	102246	1898 (1.86-1.86)
Ramachandran outliers	100387	1875 (1.86-1.86)
Sidechain outliers	100360	1875 (1.86-1.86)
RSRZ outliers	91569	1747 (1.86-1.86)

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	515	<div> <div>2%</div> <div> <div></div> <div>78%</div> <div>9%</div> <div>•</div> <div>13%</div> </div> </div>
1	B	515	<div> <div>2%</div> <div> <div></div> <div>81%</div> <div>6%</div> <div>13%</div> </div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 8238 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.

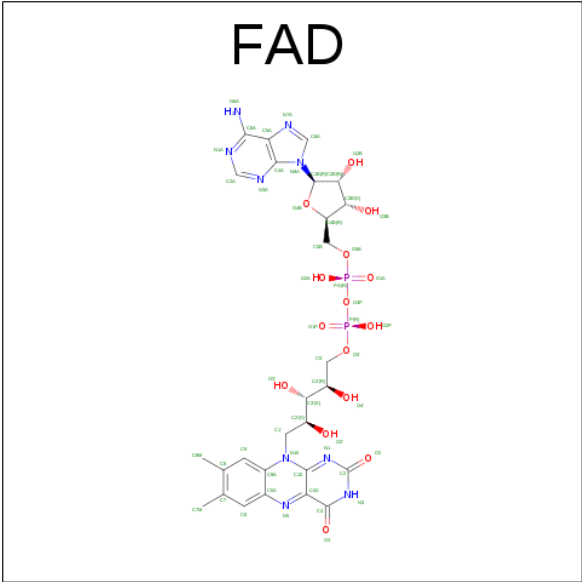
- Molecule 1 is a protein called APOPTOSIS-INDUCING FACTOR 1, MITOCHONDRIAL.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	449	Total	C	N	O	S	0	12	0
			3533	2249	623	649	12			
1	B	449	Total	C	N	O	S	0	8	0
			3518	2234	624	649	11			

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	614	LEU	-	EXPRESSION TAG	UNP O95831
A	615	VAL	-	EXPRESSION TAG	UNP O95831
A	616	PRO	-	EXPRESSION TAG	UNP O95831
A	617	ARG	-	EXPRESSION TAG	UNP O95831
A	262	SER	GLY	ENGINEERED MUTATION	UNP O95831
B	614	LEU	-	EXPRESSION TAG	UNP O95831
B	615	VAL	-	EXPRESSION TAG	UNP O95831
B	616	PRO	-	EXPRESSION TAG	UNP O95831
B	617	ARG	-	EXPRESSION TAG	UNP O95831
B	262	SER	GLY	ENGINEERED MUTATION	UNP O95831

- 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		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	552	Total	O	0	1
			553	553		
3	B	527	Total	O	0	1
			528	528		



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	91.41Å 114.57Å 120.79Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	114.53 – 1.85 71.45 – 1.85	Depositor EDS
% Data completeness (in resolution range)	98.3 (114.53-1.85) 98.3 (71.45-1.85)	Depositor EDS
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.46 (at 1.86Å)	Xtriage
Refinement program	REFMAC 5.8.0049	Depositor
R, $R_{free}$	0.179 , 0.217 0.188 , 0.221	Depositor DCC
$R_{free}$ test set	5232 reflections (5.15%)	DCC
Wilson B-factor (Å <sup>2</sup> )	21.9	Xtriage
Anisotropy	0.125	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 45.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	8238	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.28% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 5 Model quality

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: 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	0.56	0/3630	0.71	0/4907
1	B	0.54	0/3603	0.72	0/4870
All	All	0.55	0/7233	0.72	0/9777

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 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	3533	0	3605	36	0
1	B	3518	0	3567	20	1
2	A	53	0	31	0	0
2	B	53	0	31	0	0
3	A	553	0	0	14	5
3	B	528	0	0	7	4
All	All	8238	0	7234	56	5

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 4.

All (56) 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:403[B]:ASN:ND2	3:B:2165:HOH:O	1.64	1.29
1:A:263[B]:THR:HG23	1:A:403[B]:ASN:OD1	1.31	1.21
1:B:403[B]:ASN:ND2	3:B:2163[B]:HOH:O	1.78	1.13
1:A:263[B]:THR:CG2	1:A:403[B]:ASN:OD1	2.09	1.00
1:A:326:LEU:HD21	3:A:2285:HOH:O	1.84	0.78
1:A:370:GLN:HG2	1:A:384:LYS:HG2	1.77	0.66
1:A:490:VAL:HG22	3:A:2472:HOH:O	1.97	0.64
1:A:263[B]:THR:HG23	1:A:403[B]:ASN:CG	2.15	0.64
1:B:128:ALA:HB2	1:B:228:LEU:HD11	1.78	0.64
1:A:467:GLU:OE1	1:A:474:LYS:NZ	2.32	0.62
1:A:296:ILE:CD1	3:A:2268:HOH:O	2.48	0.61
1:A:267[B]:LEU:HD21	1:A:398:VAL:HG11	1.84	0.60
1:A:514:GLN:NE2	3:A:2500:HOH:O	2.35	0.59
1:B:296:ILE:HD13	1:B:393:HIS:CE1	2.39	0.56
1:B:131:HIS:HD2	1:B:252:THR:OG1	1.87	0.56
1:A:432[B]:ASN:OD1	3:A:2414:HOH:O	2.18	0.55
1:A:403[A]:ASN:ND2	3:A:2197[A]:HOH:O	0.69	0.54
1:A:343:ILE:HG23	1:A:498:VAL:HG12	1.91	0.53
1:A:405:GLU:HG3	3:A:2197[A]:HOH:O	2.08	0.53
1:B:296:ILE:HD11	3:B:2108:HOH:O	2.09	0.52
1:B:343:ILE:HG23	1:B:498:VAL:HG12	1.91	0.52
1:A:513:ALA:HB3	3:A:2495:HOH:O	2.10	0.51
1:B:455:HIS:HD2	3:B:2012:HOH:O	1.94	0.50
1:B:263:THR:HG23	1:B:264:PRO:HD2	1.93	0.50
1:A:472:ALA:HB1	1:A:474:LYS:HE3	1.93	0.50
1:B:581:ILE:HD11	1:B:610:ILE:HD11	1.94	0.50
1:A:326:LEU:HB3	3:A:2296:HOH:O	2.11	0.49
1:A:237:ASP:HB3	1:A:242[B]:MET:HE2	1.93	0.49
1:A:181:PHE:CE2	1:A:321:ARG:HD3	2.48	0.49
1:B:131:HIS:HE1	1:B:254:GLU:OE2	1.96	0.48
1:A:247:ASP:OD1	1:A:249:SER:OG	2.30	0.48
1:A:131:HIS:HE1	1:A:254:GLU:OE2	1.97	0.48
1:A:376:SER:HB2	3:A:2364:HOH:O	2.14	0.48
1:A:326:LEU:N	3:A:2296:HOH:O	2.33	0.46
1:B:455:HIS:HE1	3:B:2415:HOH:O	1.98	0.46
1:A:228:LEU:HD13	1:A:231:LYS:HG3	1.98	0.45
1:B:432[B]:ASN:OD1	3:B:2382:HOH:O	2.21	0.45
1:A:343:ILE:HG23	1:A:498:VAL:CG1	2.46	0.44
1:A:170:TYR:HB2	1:A:203[A]:ILE:HD12	1.99	0.44
1:A:263[A]:THR:HG23	1:A:264:PRO:HD2	1.99	0.44
1:A:326:LEU:HG	1:A:328:THR:HG23	2.00	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:340:MET:HE1	1:B:352:THR:HG21	2.00	0.43
1:A:340:MET:HE1	1:A:352:THR:HG21	2.01	0.43
1:B:490:VAL:HG22	3:B:2440:HOH:O	2.19	0.43
1:B:263:THR:CG2	1:B:264:PRO:HD2	2.49	0.43
1:B:264:PRO:HA	1:B:400:LEU:HD23	2.00	0.42
1:B:355:LYS:C	1:B:355:LYS:HD3	2.40	0.42
1:A:255:LYS:HE2	3:A:2414:HOH:O	2.20	0.42
1:A:187:VAL:HG23	1:A:192:ARG:O	2.20	0.41
1:B:233:VAL:HG13	1:B:243:VAL:HB	2.03	0.41
1:A:194:LYS:HE3	1:A:198:GLY:O	2.21	0.41
1:A:323:ALA:O	1:A:327:GLY:N	2.53	0.41
1:A:376:SER:N	3:A:2362:HOH:O	2.52	0.41
1:A:602:ASN:ND2	3:A:2545:HOH:O	2.55	0.40

All (5) 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)
3:A:2522:HOH:O	3:B:2489:HOH:O[2_455]	1.06	1.14
3:A:2501:HOH:O	3:B:2484:HOH:O[2_455]	1.92	0.28
3:A:2498:HOH:O	3:B:2463:HOH:O[2_455]	1.96	0.24
3:A:2360:HOH:O	3:B:2291:HOH:O[4_554]	2.04	0.16
1:B:378:LYS:NZ	3:A:2123:HOH:O[1_455]	2.17	0.03

## 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	457/515 (89%)	443 (97%)	14 (3%)	0	100	100
1	B	453/515 (88%)	437 (96%)	16 (4%)	0	100	100
All	All	910/1030 (88%)	880 (97%)	30 (3%)	0	100	100

There are no Ramachandran outliers to report.

### 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	381/424 (90%)	373 (98%)	8 (2%)	61	45
1	B	377/424 (89%)	369 (98%)	8 (2%)	61	45
All	All	758/848 (89%)	742 (98%)	16 (2%)	63	45

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	136	LEU
1	A	188	THR
1	A	228	LEU
1	A	249	SER
1	A	403[A]	ASN
1	A	403[B]	ASN
1	A	510	LYS
1	A	571	LYS
1	B	136	LEU
1	B	148	ARG
1	B	183	ASP
1	B	201	ARG
1	B	266	SER
1	B	355	LYS
1	B	510	LYS
1	B	571	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	131	HIS
1	A	454	HIS
1	B	131	HIS

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Mol	Chain	Res	Type
1	B	454	HIS
1	B	455	HIS
1	B	457	HIS
1	B	514	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](#)

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](#)

2 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	1000	-	52,58,58	1.29	8 (15%)	52,89,89	2.17	10 (19%)
2	FAD	B	1000	-	52,58,58	1.23	4 (7%)	52,89,89	2.38	11 (21%)

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	1000	-	-	0/30/50/50	0/6/6/6
2	FAD	B	1000	-	-	0/30/50/50	0/6/6/6

All (12) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1000	FAD	C2-N1	-2.12	1.33	1.38
2	A	1000	FAD	C8-C7	2.18	1.46	1.41
2	A	1000	FAD	O4B-C1B	2.22	1.44	1.41
2	A	1000	FAD	C9A-N10	2.24	1.42	1.38
2	B	1000	FAD	C2A-N3A	2.44	1.36	1.32
2	B	1000	FAD	C8-C7	2.45	1.47	1.41
2	A	1000	FAD	C4-C4X	2.75	1.46	1.41
2	A	1000	FAD	C5A-C4A	2.84	1.46	1.40
2	A	1000	FAD	C9A-C5X	2.93	1.48	1.42
2	B	1000	FAD	C9A-C5X	3.00	1.48	1.42
2	A	1000	FAD	C4X-C10	3.85	1.48	1.40
2	B	1000	FAD	C4X-C10	4.27	1.48	1.40

All (21) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1000	FAD	N3A-C2A-N1A	-7.43	123.03	128.87
2	B	1000	FAD	N3A-C2A-N1A	-7.43	123.04	128.87
2	B	1000	FAD	C4-C4X-C10	-6.87	115.54	119.94
2	A	1000	FAD	C4-C4X-C10	-4.55	117.03	119.94
2	B	1000	FAD	C4X-C10-N10	-4.52	117.23	120.52
2	A	1000	FAD	C4X-C4-N3	-4.25	117.97	123.52
2	B	1000	FAD	N3-C2-N1	-3.26	122.20	127.69
2	B	1000	FAD	C1B-N9A-C4A	-3.06	123.39	126.81
2	A	1000	FAD	C4X-C10-N10	-2.67	118.58	120.52
2	A	1000	FAD	N3-C2-N1	-2.62	123.28	127.69
2	B	1000	FAD	C4X-C4-N3	-2.50	120.26	123.52
2	A	1000	FAD	C2A-N1A-C6A	2.09	122.50	118.77
2	B	1000	FAD	O2A-PA-O3P	2.17	114.55	105.27
2	A	1000	FAD	C1'-N10-C9A	2.25	121.43	118.83
2	B	1000	FAD	C4X-N5-C5X	2.63	119.82	116.72
2	A	1000	FAD	C5X-C9A-N10	2.71	119.61	117.58
2	B	1000	FAD	N6A-C6A-N1A	2.98	123.51	118.52
2	A	1000	FAD	C4X-N5-C5X	3.53	120.89	116.72
2	B	1000	FAD	C5X-C9A-N10	4.07	120.62	117.58
2	B	1000	FAD	C4-N3-C2	8.55	122.29	115.16
2	A	1000	FAD	C4-N3-C2	8.58	122.32	115.16

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

There are no such residues in this entry.

## 5.8 Polymer linkage issues

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	449/515 (87%)	0.10	9 (2%) 68 67	11, 23, 47, 66	0
1	B	449/515 (87%)	-0.08	8 (1%) 71 71	12, 24, 46, 71	0
All	All	898/1030 (87%)	0.01	17 (1%) 70 69	11, 23, 47, 71	0

All (17) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	326	LEU	5.8
1	A	327	GLY	4.9
1	A	513	ALA	3.4
1	A	599	GLU	3.3
1	B	612	GLU	3.2
1	A	183	ASP	3.2
1	B	513	ALA	2.7
1	B	183	ASP	2.7
1	B	512	THR	2.7
1	A	376	SER	2.7
1	A	512	THR	2.6
1	B	599	GLU	2.5
1	A	472	ALA	2.5
1	B	521	THR	2.3
1	B	516	ASN	2.3
1	B	517	PRO	2.2
1	A	517	PRO	2.1

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

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

### 6.3 Carbohydrates [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	1000	53/53	0.98	0.10	-0.53	11,14,15,17	0
2	FAD	B	1000	53/53	0.98	0.09	-0.56	12,15,17,19	0

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

There are no such residues in this entry.