



# Full wwPDB X-ray Structure Validation Report ⓘ

Jan 25, 2021 – 01:59 PM EST

PDB ID : 6VP4  
Title : Ethylene forming enzyme (EFE) in complex with Fe(II), L-arginine, and 2OG  
Authors : Davis, K.M.; Copeland, R.A.; Boal, A.K.  
Deposited on : 2020-02-01  
Resolution : 1.83 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 : 2.16  
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) : 2.16

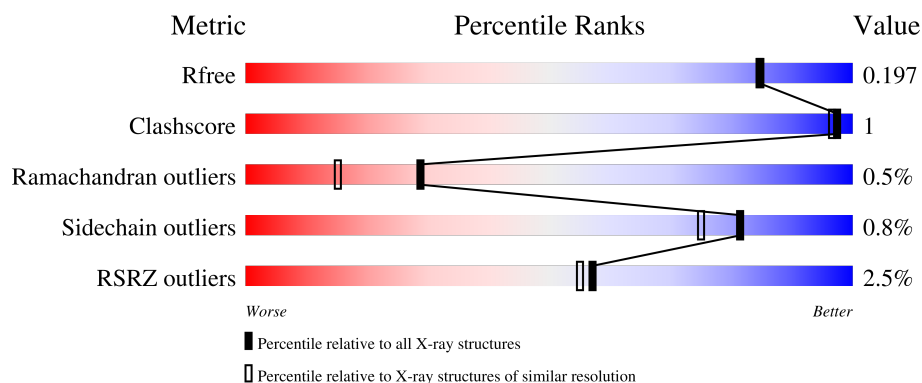
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.83 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	4003 (1.86-1.82)
Clashscore	141614	4233 (1.86-1.82)
Ramachandran outliers	138981	4185 (1.86-1.82)
Sidechain outliers	138945	4186 (1.86-1.82)
RSRZ outliers	127900	3957 (1.86-1.82)

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	350	<div> <div>2%</div> <div>92%</div> <div>5%</div> </div>
1	B	350	<div> <div>3%</div> <div>95%</div> <div>•</div> </div>
1	C	350	<div> <div>2%</div> <div>92%</div> <div>5%</div> </div>
1	D	350	<div> <div>3%</div> <div>91%</div> <div>5%</div> </div>

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 11760 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.

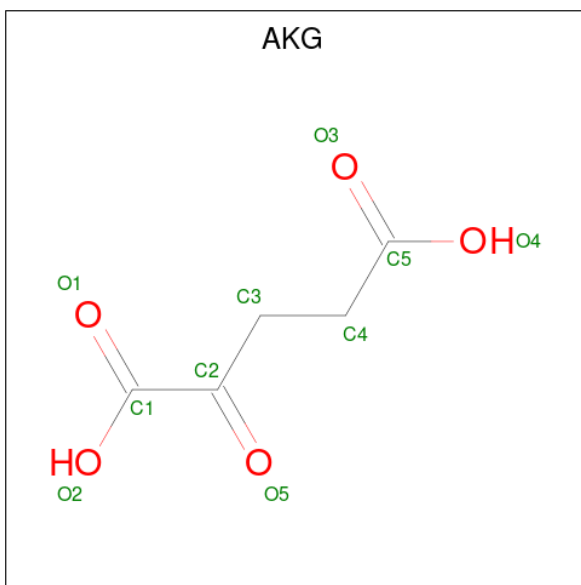
- Molecule 1 is a protein called 2-oxoglutarate-dependent ethylene/succinate-forming enzyme.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	333	Total	C	N	O	S	0	4	0
			2618	1670	447	485	16			
1	B	340	Total	C	N	O	S	0	4	0
			2685	1706	458	503	18			
1	C	339	Total	C	N	O	S	0	2	0
			2651	1690	453	492	16			
1	D	331	Total	C	N	O	S	0	3	0
			2588	1652	443	478	15			

- Molecule 2 is FE (III) ION (three-letter code: FE) (formula: Fe).

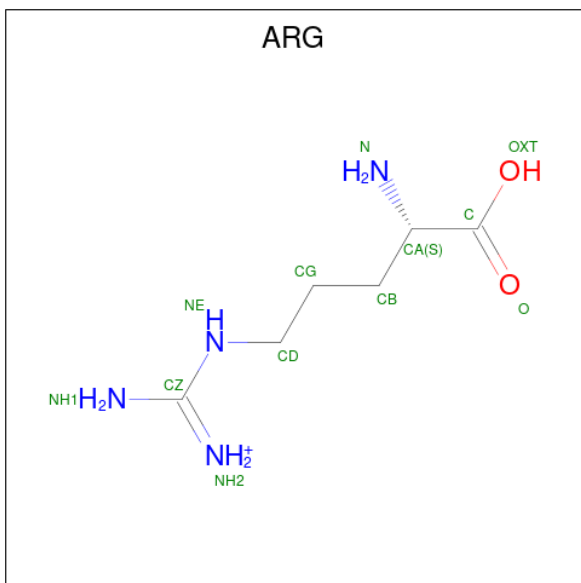
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	1	Total	Fe	0	0
			1	1		
2	A	1	Total	Fe	0	0
			1	1		
2	D	1	Total	Fe	0	0
			1	1		
2	C	1	Total	Fe	0	0
			1	1		

- Molecule 3 is 2-OXOGLUTARIC ACID (three-letter code: AKG) (formula: C<sub>5</sub>H<sub>6</sub>O<sub>5</sub>).



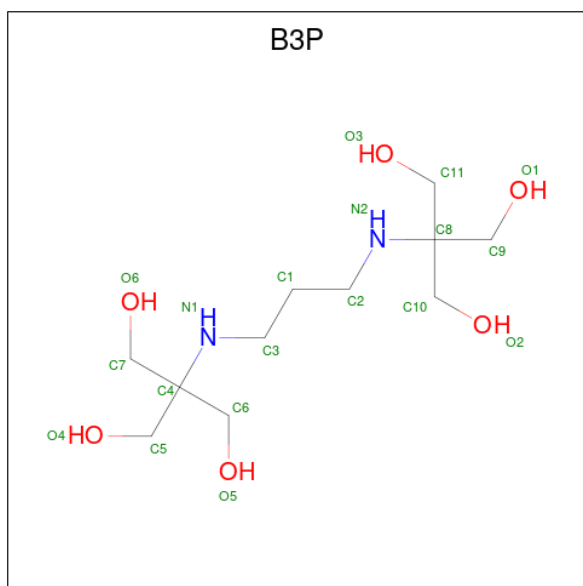
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			10	5	5		
3	B	1	Total	C	O	0	0
			10	5	5		
3	C	1	Total	C	O	0	0
			10	5	5		
3	D	1	Total	C	O	0	0
			10	5	5		

- Molecule 4 is ARGinine (three-letter code: ARG) (formula:  $C_6H_{15}N_4O_2$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	N	O	0	0
			12	6	4	2		
4	B	1	Total	C	N	O	0	0
			12	6	4	2		
4	C	1	Total	C	N	O	0	0
			12	6	4	2		
4	D	1	Total	C	N	O	0	0
			12	6	4	2		

- Molecule 5 is 2-[3-(2-HYDROXY-1,1-DIHYDROXYMETHYL-ETHYLAMINO)-PROPYL AMINO]-2-HYDROXYMETHYL-PROPANE-1,3-DIOL (three-letter code: B3P) (formula:  $C_{11}H_{26}N_2O_6$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	D	1	Total	C	N	O	0	0
			19	11	2	6		

- Molecule 6 is water.

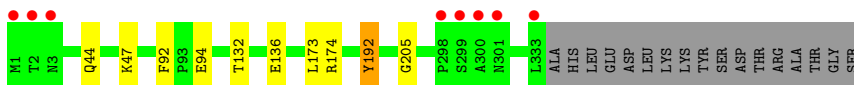
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	266	Total	O	0	0
			266	266		
6	B	319	Total	O	0	0
			319	319		
6	C	269	Total	O	0	0
			269	269		
6	D	253	Total	O	0	0
			253	253		

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

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ( $RSRZ > 2$ ). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

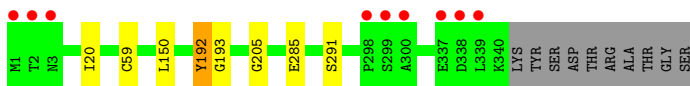
- Molecule 1: 2-oxoglutarate-dependent ethylene/succinate-forming enzyme

Chain A: 



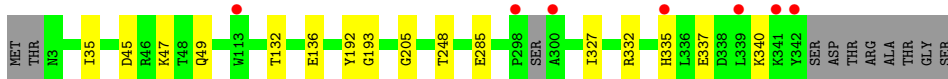
- Molecule 1: 2-oxoglutarate-dependent ethylene/succinate-forming enzyme

Chain B: 

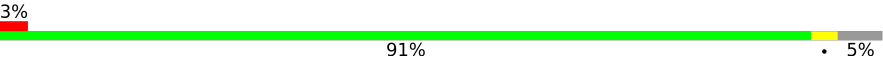


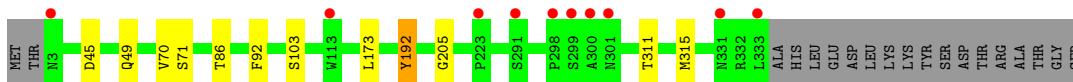
- Molecule 1: 2-oxoglutarate-dependent ethylene/succinate-forming enzyme

Chain C: 



- Molecule 1: 2-oxoglutarate-dependent ethylene/succinate-forming enzyme

Chain D: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	49.73Å 78.81Å 195.91Å 90.00° 92.67° 90.00°	Depositor
Resolution (Å)	40.77 – 1.83 41.57 – 1.83	Depositor EDS
% Data completeness (in resolution range)	98.8 (40.77-1.83) 91.6 (41.57-1.83)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.00 (at 1.83Å)	Xtriage
Refinement program	PHENIX 1.15.2_3472	Depositor
R, $R_{free}$	0.174 , 0.197 0.174 , 0.197	Depositor DCC
$R_{free}$ test set	2005 reflections (1.52%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	19.8	Xtriage
Anisotropy	0.402	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 50.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.027 for h,-k,-l	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	11760	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	25.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 20.36 % 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 8.8331e-03. 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

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: B3P, AKG, FE

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	0.39	0/2696	0.52	1/3672 (0.0%)
1	B	0.33	0/2759	0.51	1/3754 (0.0%)
1	C	0.33	0/2726	0.48	1/3712 (0.0%)
1	D	0.31	0/2668	0.49	1/3634 (0.0%)
All	All	0.34	0/10849	0.50	4/14772 (0.0%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	192	TYR	N-CA-C	5.93	127.00	111.00
1	B	192	TYR	N-CA-C	5.88	126.87	111.00
1	D	192	TYR	N-CA-C	5.70	126.38	111.00
1	A	192	TYR	N-CA-C	5.53	125.93	111.00

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	2618	0	2490	4	0
1	B	2685	0	2541	2	0
1	C	2651	0	2500	7	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	D	2588	0	2459	4	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
3	A	10	0	4	0	0
3	B	10	0	4	0	0
3	C	10	0	4	0	0
3	D	10	0	4	0	0
4	A	12	0	12	0	0
4	B	12	0	12	0	0
4	C	12	0	12	0	0
4	D	12	0	12	1	0
5	D	19	0	26	0	0
6	A	266	0	0	0	0
6	B	319	0	0	0	0
6	C	269	0	0	0	0
6	D	253	0	0	0	0
All	All	11760	0	10080	17	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 1.

All (17) 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:86:THR:HG1	4:D:403:ARG:N	1.97	0.62
1:A:47:LYS:HE2	1:A:132[B]:THR:CG2	2.34	0.58
1:C:337:GLU:HA	1:C:340:LYS:HD3	1.87	0.56
1:A:47:LYS:HE2	1:A:132[B]:THR:HG22	1.93	0.51
1:B:193:GLY:HA3	1:B:285:GLU:OE1	2.11	0.49
1:C:47:LYS:HD2	1:C:136:GLU:HG3	1.96	0.47
1:D:45:ASP:O	1:D:49:GLN:HG2	2.16	0.46
1:C:35:ILE:HD11	1:C:248:THR:HB	1.97	0.46
1:A:44:GLN:HG2	1:A:136:GLU:HG3	1.96	0.46
1:D:311:THR:O	1:D:315:MET:HG3	2.18	0.43
1:C:45:ASP:O	1:C:49:GLN:HG2	2.19	0.43
1:A:94:GLU:OE2	1:A:174:ARG:NE	2.45	0.42
1:C:47:LYS:HD3	1:C:132[A]:THR:HG22	2.01	0.42
1:C:193:GLY:HA3	1:C:285:GLU:OE2	2.20	0.41
1:C:327:ILE:HA	1:C:332:ARG:HG3	2.02	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:20:ILE:HD13	1:B:150:LEU:HB3	2.01	0.41
1:D:70:VAL:HG12	1:D:71:SER:N	2.37	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	335/350 (96%)	327 (98%)	6 (2%)	2 (1%)	25	12
1	B	342/350 (98%)	335 (98%)	6 (2%)	1 (0%)	41	27
1	C	337/350 (96%)	331 (98%)	5 (2%)	1 (0%)	41	27
1	D	332/350 (95%)	325 (98%)	5 (2%)	2 (1%)	25	12
All	All	1346/1400 (96%)	1318 (98%)	22 (2%)	6 (0%)	29	20

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	205	GLY
1	B	205	GLY
1	D	205	GLY
1	A	92	PHE
1	C	205	GLY
1	D	92	PHE

### 5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	274/300 (91%)	272 (99%)	2 (1%)	84	78
1	B	282/300 (94%)	278 (99%)	4 (1%)	67	55
1	C	275/300 (92%)	274 (100%)	1 (0%)	91	88
1	D	270/300 (90%)	267 (99%)	3 (1%)	73	64
All	All	1101/1200 (92%)	1091 (99%)	10 (1%)	81	71

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	173	LEU
1	A	192	TYR
1	B	59[A]	CYS
1	B	59[B]	CYS
1	B	192	TYR
1	B	291	SER
1	C	335	HIS
1	D	103	SER
1	D	173	LEU
1	D	192	TYR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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 monosaccharides in this entry.

## 5.6 Ligand geometry

Of 13 ligands modelled in this entry, 4 are monoatomic - leaving 9 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	B3P	D	404	-	18,18,18	0.11	0	21,23,23	0.33	0
3	AKG	B	402	2	3,9,9	0.49	0	4,11,11	1.21	0
3	AKG	D	402	2	3,9,9	0.58	0	4,11,11	1.18	0
4	ARG	D	403	-	7,11,11	0.25	0	6,13,13	0.28	0
4	ARG	C	403	-	7,11,11	0.27	0	6,13,13	0.34	0
4	ARG	B	403	-	7,11,11	0.33	0	6,13,13	0.29	0
4	ARG	A	403	-	7,11,11	0.33	0	6,13,13	0.26	0
3	AKG	A	402	2	3,9,9	0.33	0	4,11,11	1.05	0
3	AKG	C	402	2	3,9,9	0.45	0	4,11,11	1.24	0

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
5	B3P	D	404	-	-	0/28/28/28	-
3	AKG	B	402	2	-	2/3/9/9	-
3	AKG	D	402	2	-	2/3/9/9	-
4	ARG	D	403	-	-	0/7/11/11	-
4	ARG	C	403	-	-	1/7/11/11	-
4	ARG	B	403	-	-	0/7/11/11	-
4	ARG	A	403	-	-	0/7/11/11	-
3	AKG	A	402	2	-	2/3/9/9	-
3	AKG	C	402	2	-	2/3/9/9	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (9) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	D	402	AKG	O5-C2-C3-C4
3	A	402	AKG	O5-C2-C3-C4
3	D	402	AKG	C1-C2-C3-C4
3	A	402	AKG	C1-C2-C3-C4
3	C	402	AKG	O5-C2-C3-C4
3	B	402	AKG	C1-C2-C3-C4
3	B	402	AKG	O5-C2-C3-C4
3	C	402	AKG	C1-C2-C3-C4
4	C	403	ARG	NE-CD-CG-CB

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	D	403	ARG	1	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

### 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	333/350 (95%)	-0.18	8 (2%) 59 57	15, 23, 41, 77	0
1	B	340/350 (97%)	-0.24	9 (2%) 56 53	13, 19, 40, 63	0
1	C	339/350 (96%)	-0.22	7 (2%) 63 62	16, 23, 43, 65	0
1	D	331/350 (94%)	-0.18	10 (3%) 50 47	15, 23, 43, 66	0
All	All	1343/1400 (95%)	-0.20	34 (2%) 57 55	13, 22, 42, 77	0

All (34) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	339	LEU	5.9
1	D	300	ALA	5.4
1	D	299	SER	5.1
1	A	299	SER	5.1
1	B	298	PRO	5.1
1	B	299	SER	4.9
1	C	342	TYR	4.8
1	D	223	PRO	4.7
1	A	2	THR	4.5
1	B	338	ASP	4.2
1	A	298	PRO	4.2
1	B	2	THR	4.1
1	A	1	MET	4.0
1	D	298	PRO	3.8
1	C	341	LYS	3.4
1	A	300	ALA	3.3
1	D	333	LEU	3.2
1	A	333	LEU	3.0
1	B	1	MET	3.0
1	A	301	ASN	2.9
1	B	339	LEU	2.9

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Mol	Chain	Res	Type	RSRZ
1	B	337	GLU	2.8
1	B	3	ASN	2.7
1	C	335	HIS	2.7
1	D	331	ASN	2.6
1	C	113	TRP	2.4
1	A	3	ASN	2.4
1	C	298	PRO	2.3
1	C	300	ALA	2.2
1	D	113	TRP	2.2
1	D	291	SER	2.2
1	B	300	ALA	2.1
1	D	301	ASN	2.1
1	D	3	ASN	2.0

## 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( $\text{\AA}^2$ )	Q<0.9
5	B3P	D	404	19/19	0.78	0.18	31,39,55,58	0
3	AKG	C	402	10/10	0.94	0.09	22,24,26,26	0
3	AKG	D	402	10/10	0.95	0.08	22,25,27,28	0
3	AKG	A	402	10/10	0.95	0.10	20,22,25,26	0
3	AKG	B	402	10/10	0.95	0.10	16,21,22,23	0
4	ARG	C	403	12/12	0.97	0.08	18,21,24,25	0
4	ARG	A	403	12/12	0.97	0.09	18,21,23,26	0
4	ARG	D	403	12/12	0.97	0.07	19,21,25,25	0
4	ARG	B	403	12/12	0.97	0.09	15,17,19,21	0
2	FE	A	401	1/1	0.99	0.07	18,18,18,18	0

*Continued on next page...*

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
2	FE	D	401	1/1	0.99	0.07	18,18,18,18	0
2	FE	B	401	1/1	1.00	0.11	15,15,15,15	0
2	FE	C	401	1/1	1.00	0.09	19,19,19,19	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.