



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 02:00 AM GMT

PDB ID : 2F5V  
Title : Reaction geometry and thermostability mutant of pyranose 2-oxidase from the white-rot fungus *Peniophora* sp.  
Authors : Bannwarth, M.; Bastian, S.; Heckmann-Pohl, D.; Giffhorn, F.; Schulz, G.E.  
Deposited on : 2005-11-28  
Resolution : 1.41 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 (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

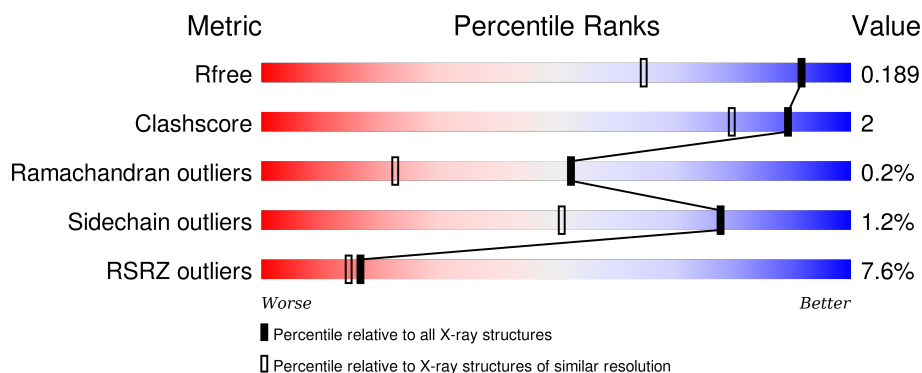
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 1.41 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	1632 (1.44-1.40)
Clashscore	102246	1743 (1.44-1.40)
Ramachandran outliers	100387	1698 (1.44-1.40)
Sidechain outliers	100360	1697 (1.44-1.40)
RSRZ outliers	91569	1632 (1.44-1.40)

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	595	<div> <div>7%</div> <div>90%</div> <div>6%</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 criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	PG4	A	1626	-	-	-	X

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Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
5	PEG	A	1627	-	-	-	X

## 2 Entry composition [i](#)

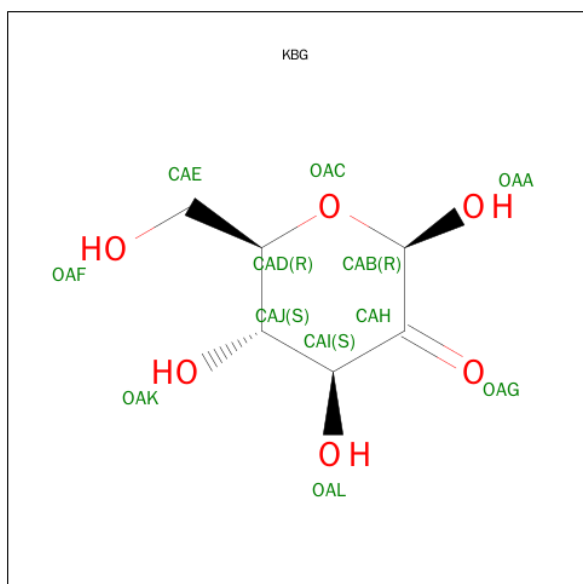
There are 6 unique types of molecules in this entry. The entry contains 5434 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Pyranose 2-oxidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	577	4549	2872	778	874	25	0	0	0

- Molecule 2 is SUGAR (BETA-D-GLUCOSE) (three-letter code: KBG) (formula: C<sub>6</sub>H<sub>10</sub>O<sub>6</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
2	A	1	12	6	6	0	0

- Molecule 3 is FLAVIN-ADENINE DINUCLEOTIDE (three-letter code: FAD) (formula: C<sub>27</sub>H<sub>33</sub>N<sub>9</sub>O<sub>15</sub>P<sub>2</sub>).



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

- Molecule 4 is TETRAETHYLENE GLYCOL (three-letter code: PG4) (formula:  $C_8H_{18}O_5$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			13	8	5		

- Molecule 5 is DI(HYDROXYETHYL)ETHER (three-letter code: PEG) (formula:  $C_4H_{10}O_3$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			7	4	3		

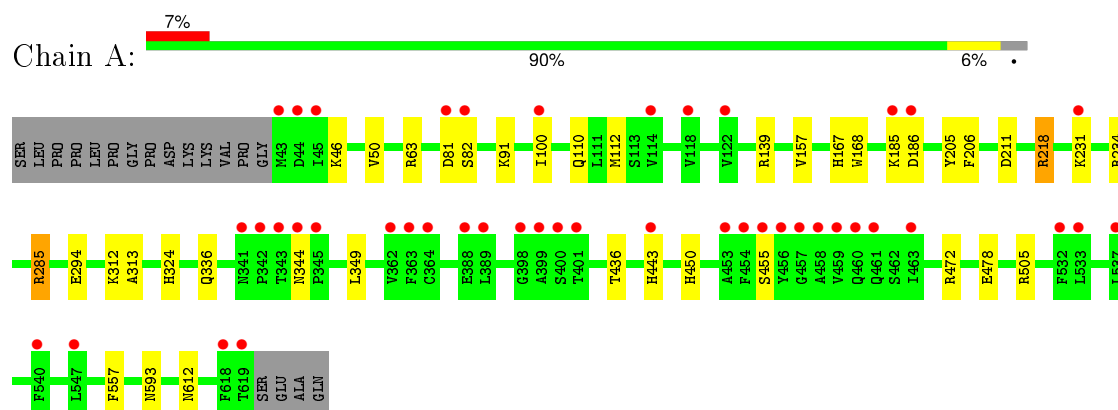
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	800	Total	O	0	0
			800	800		

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

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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: Pyranose 2-oxidase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 42 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	102.19Å 102.19Å 119.86Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	62.00 – 1.41 61.89 – 1.41	Depositor EDS
% Data completeness (in resolution range)	100.0 (62.00-1.41) 98.3 (61.89-1.41)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.06	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	23.48 (at 1.41Å)	Xtriage
Refinement program	REFMAC 5.2.0005	Depositor
R, $R_{free}$	0.149 , 0.178 0.160 , 0.189	Depositor DCC
$R_{free}$ test set	2384 reflections (2.04%)	DCC
Wilson B-factor (Å <sup>2</sup> )	11.6	Xtriage
Anisotropy	0.135	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 41.5	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.45$ , $\langle L^2 \rangle = 0.27$	Xtriage
Outliers	0 of 119164 reflections	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	5434	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	20.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.32% 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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: PG4, PEG, KBG, 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	0.72	1/4665 (0.0%)	0.83	7/6343 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	2

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	478	GLU	CD-OE1	5.45	1.31	1.25

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	218	ARG	NE-CZ-NH1	10.08	125.34	120.30
1	A	139	ARG	NE-CZ-NH1	9.48	125.04	120.30
1	A	139	ARG	NE-CZ-NH2	-9.39	115.61	120.30
1	A	505	ARG	NE-CZ-NH1	8.11	124.35	120.30
1	A	285	ARG	NE-CZ-NH1	5.51	123.06	120.30
1	A	349	LEU	CB-CG-CD2	5.25	119.92	111.00
1	A	211	ASP	CB-CG-OD1	5.08	122.88	118.30

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	436	THR	Peptide
1	A	455	SER	Peptide

## 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	4549	0	4395	21	0
2	A	12	0	9	0	0
3	A	53	0	30	1	0
4	A	13	0	18	0	0
5	A	7	0	10	2	0
6	A	800	0	0	5	0
All	All	5434	0	4462	22	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 2.

All (22) 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:110:GLN:HE21	1:A:167:HIS:HD1	1.31	0.79
1:A:91:LYS:HD3	1:A:100:ILE:HD11	1.81	0.63
1:A:450:HIS:HD2	6:A:1740:HOH:O	1.87	0.57
1:A:612:ASN:HA	5:A:1627:PEG:H12	1.87	0.56
1:A:81:ASP:HB2	6:A:1773:HOH:O	2.08	0.52
5:A:1627:PEG:H31	6:A:2311:HOH:O	2.12	0.50
1:A:218:ARG:HD2	6:A:1655:HOH:O	2.13	0.49
1:A:450:HIS:CE1	1:A:472:ARG:HH11	2.32	0.47
1:A:231:LYS:HD3	1:A:231:LYS:N	2.30	0.47
1:A:336:GLN:NE2	1:A:344:ASN:O	2.48	0.47
1:A:63:ARG:NE	1:A:205:TYR:CE1	2.84	0.46
1:A:185:LYS:HE2	1:A:557:PHE:CD2	2.51	0.46
1:A:46:LYS:HD3	1:A:312:LYS:HG3	1.98	0.45
1:A:46:LYS:HD3	1:A:312:LYS:CG	2.48	0.44
1:A:234:ARG:HE	1:A:443:HIS:CE1	2.35	0.43
1:A:157:VAL:HG21	1:A:324:HIS:HE1	1.83	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:231:LYS:HD3	1:A:231:LYS:H	1.83	0.43
1:A:63:ARG:HD3	1:A:205:TYR:CZ	2.54	0.43
1:A:231:LYS:CD	1:A:231:LYS:N	2.81	0.42
1:A:285:ARG:HD3	6:A:2308:HOH:O	2.20	0.41
1:A:50:VAL:HG23	1:A:313:ALA:HB2	2.02	0.40
1:A:167:HIS:CD2	3:A:1625:FAD:C7M	3.04	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	575/595 (97%)	560 (97%)	14 (2%)	1 (0%)	52 23

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	82	SER

### 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	505/520 (97%)	499 (99%)	6 (1%)	78 51

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	112	MET
1	A	168	TRP
1	A	186	ASP
1	A	206	PHE
1	A	294	GLU
1	A	593	ASN

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

Mol	Chain	Res	Type
1	A	108	GLN
1	A	450	HIS

### 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](#)

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
3	FAD	A	1625	1	48,58,58	1.29	5 (10%)	54,89,89	2.03	9 (16%)
4	PG4	A	1626	-	12,12,12	0.69	0	11,11,11	0.65	0
5	PEG	A	1627	-	6,6,6	0.95	0	5,5,5	0.93	0
2	KBG	A	1628	-	12,12,12	1.74	3 (25%)	10,17,17	1.89	4 (40%)

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
3	FAD	A	1625	1	-	0/30/50/50	0/6/6/6
4	PG4	A	1626	-	-	0/10/10/10	0/0/0/0
5	PEG	A	1627	-	-	0/4/4/4	0/0/0/0
2	KBG	A	1628	-	-	0/2/22/22	0/1/1/1

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1628	KBG	OAL-CAI	-3.05	1.36	1.42
2	A	1628	KBG	CAB-CAH	2.05	1.54	1.52
3	A	1625	FAD	C7M-C7	2.05	1.55	1.51
3	A	1625	FAD	C4X-N5	2.43	1.37	1.33
3	A	1625	FAD	C5'-C4'	2.89	1.56	1.51
2	A	1628	KBG	OAC-CAB	3.86	1.47	1.41
3	A	1625	FAD	O4B-C1B	3.89	1.46	1.41
3	A	1625	FAD	C4-N3	4.26	1.41	1.33

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	1625	FAD	C4X-C4-N3	-4.86	116.94	123.59
3	A	1625	FAD	N3A-C2A-N1A	-3.93	125.89	128.89
2	A	1628	KBG	OAC-CAD-CAJ	-3.13	103.80	109.68
2	A	1628	KBG	CAE-CAD-CAJ	-2.58	106.66	113.02
3	A	1625	FAD	C4A-C5A-N7A	-2.55	107.13	109.48
3	A	1625	FAD	C4-C4X-C10	-2.34	118.45	119.94
2	A	1628	KBG	OAL-CAI-CAJ	-2.06	105.74	109.95
3	A	1625	FAD	C4B-O4B-C1B	-2.01	107.51	109.72
3	A	1625	FAD	C4-C4X-N5	2.21	121.40	118.72
3	A	1625	FAD	C4X-N5-C5X	2.48	119.62	116.76
2	A	1628	KBG	OAC-CAD-CAE	2.70	113.17	106.36

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	1625	FAD	C1'-N10-C9A	4.04	123.39	118.86
3	A	1625	FAD	C4-N3-C2	10.68	124.48	115.25

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	1625	FAD	1	0
5	A	1627	PEG	2	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	577/595 (96%)	0.91	44 (7%) 17 15	12, 18, 27, 44	0

All (44) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	459	VAL	13.6
1	A	457	GLY	11.6
1	A	619	THR	10.2
1	A	344	ASN	7.6
1	A	45	ILE	7.3
1	A	455	SER	7.2
1	A	458	ALA	6.7
1	A	341	ASN	6.4
1	A	401	THR	6.3
1	A	343	THR	5.7
1	A	456	TYR	5.7
1	A	342	PRO	5.3
1	A	400	SER	4.8
1	A	43	MET	4.8
1	A	618	PHE	4.7
1	A	454	PHE	4.5
1	A	44	ASP	4.2
1	A	399	ALA	4.0
1	A	537	LEU	3.5
1	A	461	GLN	3.1
1	A	82	SER	3.0
1	A	345	PRO	3.0
1	A	185	LYS	2.9
1	A	231	LYS	2.8
1	A	81	ASP	2.6
1	A	100	ILE	2.5
1	A	463	ILE	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	460	GLN	2.4
1	A	532	PHE	2.4
1	A	186	ASP	2.3
1	A	118	VAL	2.2
1	A	398	GLY	2.2
1	A	453	ALA	2.2
1	A	364	CYS	2.1
1	A	362	VAL	2.1
1	A	533	LEU	2.1
1	A	540	PHE	2.1
1	A	114	VAL	2.1
1	A	122	VAL	2.1
1	A	388	GLU	2.1
1	A	389	LEU	2.1
1	A	443	HIS	2.0
1	A	363	PHE	2.0
1	A	547	LEU	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 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
4	PG4	A	1626	13/13	0.78	0.23	7.03	22,29,41,43	0
5	PEG	A	1627	7/7	0.63	0.20	3.82	30,32,35,35	0
2	KBG	A	1628	12/12	0.87	0.17	1.20	8,13,18,20	12
3	FAD	A	1625	53/53	0.95	0.11	-0.38	16,17,19,20	0



## 6.5 Other polymers [i](#)

There are no such residues in this entry.