



Full wwPDB X-ray Structure Validation Report ⓘ

Nov 6, 2023 – 07:03 PM EST

PDB ID : 6PER
Title : Crystal Structure of Ligand-Free iSeroSnFR
Authors : Hartanto, S.; Tian, L.; Fisher, A.J.
Deposited on : 2019-06-20
Resolution : 2.10 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

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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)
Xtrriage (Phenix) : 1.13
EDS : 2.36
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) : 2.36

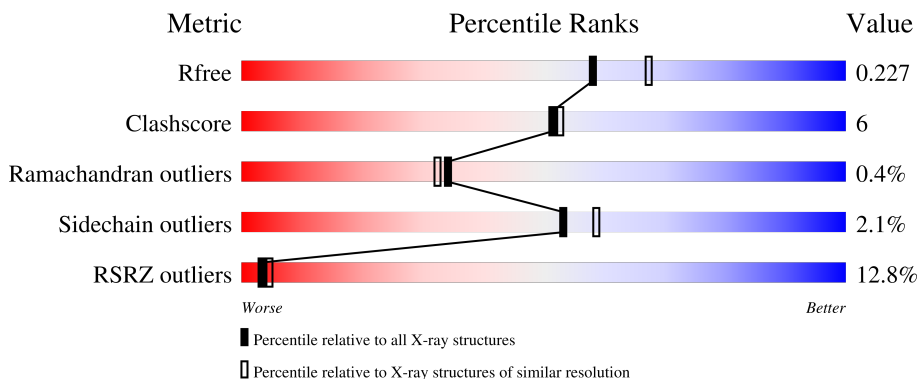
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.10 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	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

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 ≥ 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	555	

2 Entry composition [i](#)

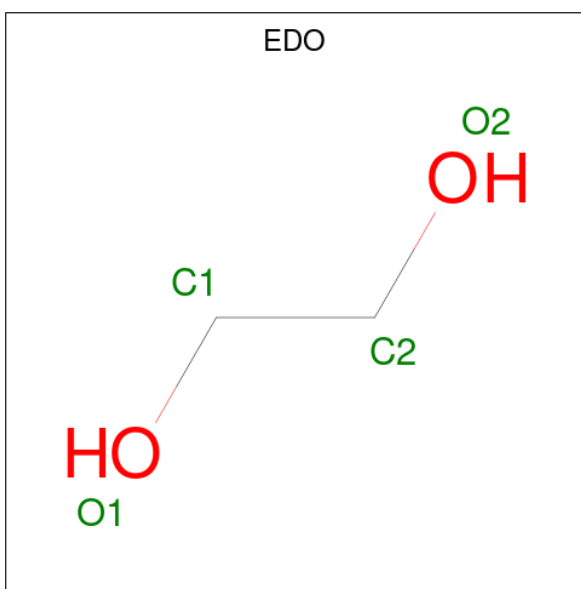
There are 3 unique types of molecules in this entry. The entry contains 4269 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 iSeroSnFR, a soluble, genetically-encoded fluorescent sensor for serotonin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	507	4024	2578	667	767	12	0	2	0

- Molecule 2 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C₂H₆O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
2	A	1	4	2	2	0	0
2	A	1	4	2	2	0	0
2	A	1	4	2	2	0	0
2	A	1	4	2	2	0	0
2	A	1	4	2	2	0	0

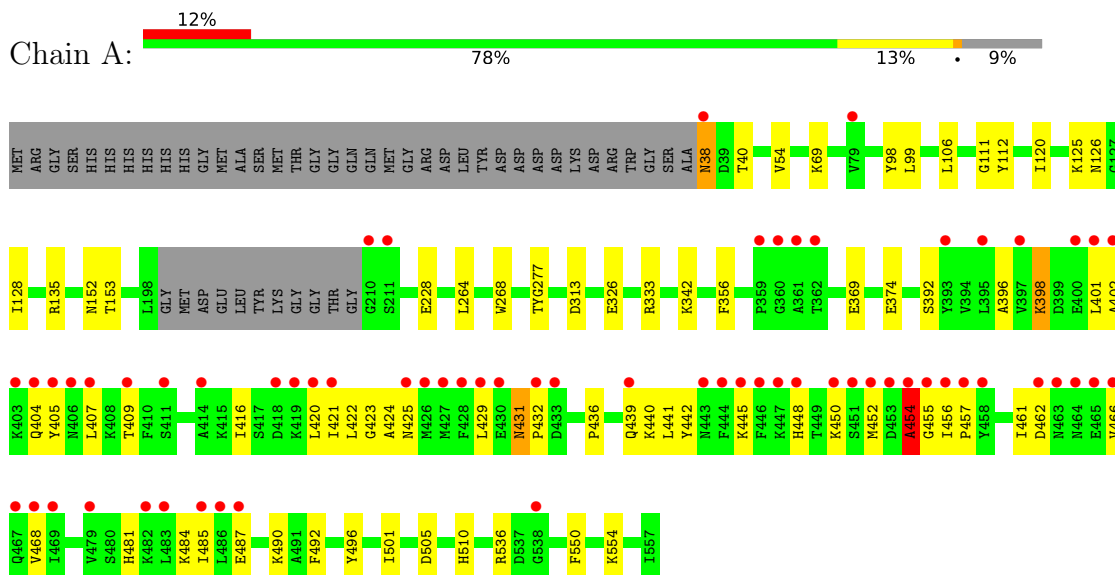
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	225	Total 225	O 225	0	0

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: iSeroSnFR, a soluble, genetically-encoded fluorescent sensor for serotonin



4 Data and refinement statistics

Property	Value	Source
Space group	I 2 2 2	Depositor
Cell constants a, b, c, α , β , γ	80.67Å 99.25Å 150.56Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	62.60 – 2.10 82.87 – 2.10	Depositor EDS
% Data completeness (in resolution range)	93.2 (62.60-2.10) 97.6 (82.87-2.10)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.91 (at 2.10Å)	Xtrriage
Refinement program	PHENIX (1.14_3260: ???)	Depositor
R, R_{free}	0.188 , 0.232 0.186 , 0.227	Depositor DCC
R_{free} test set	1778 reflections (5.11%)	wwPDB-VP
Wilson B-factor (Å ²)	33.1	Xtrriage
Anisotropy	0.248	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 54.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	4269	wwPDB-VP
Average B, all atoms (Å ²)	43.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.30% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: CRO, EDO

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	0.43	0/4091	0.60	0/5531

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	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	454	ALA	Peptide

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	4024	0	4014	45	0
2	A	20	0	30	0	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	225	0	0	1	0
All	All	4269	0	4044	45	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 6.

All (45) 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:424:ALA:HB3	1:A:429:LEU:CD1	2.02	0.90
1:A:424:ALA:HB3	1:A:429:LEU:HD13	1.57	0.86
1:A:421:ILE:HG21	1:A:450:LYS:HE3	1.64	0.79
1:A:401:LEU:HA	1:A:404:GLN:OE1	1.87	0.74
1:A:228:GLU:OE1	1:A:333:ARG:NH1	2.21	0.73
1:A:423:GLY:H	1:A:466:VAL:HG11	1.54	0.71
1:A:120:ILE:HD11	1:A:440:LYS:HD3	1.73	0.70
1:A:409:THR:HG22	1:A:487:GLU:HB3	1.74	0.69
1:A:392:SER:HA	1:A:496:TYR:HD1	1.62	0.65
1:A:454:ALA:O	1:A:456:ILE:N	2.29	0.63
1:A:112:TYR:HE2	1:A:374:GLU:HG3	1.64	0.63
1:A:111:GLY:HA3	1:A:135:ARG:HD3	1.85	0.59
1:A:505:ASP:HB2	3:A:1245:HOH:O	2.03	0.58
1:A:550:PHE:CZ	1:A:554:LYS:HD2	2.39	0.58
1:A:423:GLY:N	1:A:466:VAL:HG11	2.18	0.57
1:A:421:ILE:CG2	1:A:450:LYS:HE3	2.32	0.56
1:A:424:ALA:HB3	1:A:429:LEU:HD11	1.88	0.55
1:A:38:ASN:HB3	1:A:510:HIS:NE2	2.21	0.55
1:A:425:ASN:HA	1:A:452:MET:O	2.06	0.55
1:A:431:ASN:HD22	1:A:432:PRO:HD2	1.73	0.54
1:A:462:ASP:OD2	1:A:481:HIS:ND1	2.32	0.54
1:A:422:LEU:HD11	1:A:424:ALA:HB2	1.91	0.53
1:A:485:ILE:O	1:A:485:ILE:HG13	2.09	0.53
1:A:421:ILE:HG23	1:A:448:HIS:O	2.09	0.53
1:A:313:ASP:O	1:A:342:LYS:HE2	2.10	0.52
1:A:416:ILE:HG22	1:A:420:LEU:HD13	1.94	0.50
1:A:422:LEU:HD23	1:A:468:VAL:HB	1.93	0.50
1:A:405:TYR:HB2	1:A:407:LEU:HD21	1.95	0.48
1:A:398:LYS:HE2	1:A:461:ILE:HG12	1.96	0.47
1:A:436:PRO:O	1:A:440:LYS:HG3	2.15	0.47
1:A:398:LYS:HE3	1:A:398:LYS:HB2	1.65	0.47
1:A:441:LEU:HD23	1:A:492:PHE:HB2	1.97	0.46

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:54:VAL:HG11	1:A:99:LEU:HD22	1.98	0.46
1:A:416:ILE:HG22	1:A:416:ILE:O	2.18	0.44
1:A:125:LYS:O	1:A:153:THR:HG23	2.18	0.43
1:A:442:TYR:CE1	1:A:490:LYS:HD3	2.53	0.43
1:A:326:GLU:OE1	1:A:333:ARG:NH2	2.51	0.42
1:A:98:TYR:CE1	1:A:501:ILE:HD11	2.54	0.42
1:A:40:THR:HG22	1:A:69:LYS:CG	2.50	0.42
1:A:456:ILE:N	1:A:457:PRO:HD2	2.35	0.41
1:A:396:ALA:HA	1:A:484:LYS:O	2.19	0.41
1:A:106:LEU:HD12	1:A:106:LEU:HA	1.80	0.41
1:A:402:ALA:O	1:A:407:LEU:HG	2.21	0.41
1:A:264:LEU:HD22	1:A:268:TRP:CE2	2.56	0.41
1:A:128:ILE:HG13	1:A:152:ASN:HB2	2.01	0.41

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	502/555 (90%)	484 (96%)	16 (3%)	2 (0%)	34 32

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	455	GLY
1	A	454	ALA

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	436/470 (93%)	427 (98%)	9 (2%)	53 59

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	38	ASN
1	A	126	ASN
1	A	356	PHE
1	A	369	GLU
1	A	398	LYS
1	A	431	ASN
1	A	439	GLN
1	A	445	LYS
1	A	536	ARG

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

Mol	Chain	Res	Type
1	A	431	ASN
1	A	443	ASN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

1 non-standard protein/DNA/RNA residue is 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
1	CRO	A	277	1	23,23,24	4.19	6 (26%)	30,32,34	4.28	10 (33%)

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
1	CRO	A	277	1	-	2/12/31/32	0/2/2/2

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	277	CRO	CB2-CA2	18.65	1.50	1.35
1	A	277	CRO	C2-N3	-3.92	1.30	1.39
1	A	277	CRO	C1-N2	3.39	1.37	1.32
1	A	277	CRO	O2-C2	3.26	1.30	1.23
1	A	277	CRO	CA2-C2	-2.60	1.46	1.48
1	A	277	CRO	CG2-CB2	2.32	1.51	1.46

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	277	CRO	CA2-C2-N3	16.49	111.17	103.37
1	A	277	CRO	O2-C2-CA2	-10.03	125.33	130.96
1	A	277	CRO	C2-CA2-N2	-7.69	103.55	108.93
1	A	277	CRO	CG2-CB2-CA2	-6.27	122.27	129.94
1	A	277	CRO	CB2-CA2-N2	4.45	135.00	128.83
1	A	277	CRO	C2-N3-C1	-3.38	106.25	107.97
1	A	277	CRO	CA2-N2-C1	2.58	107.67	105.77
1	A	277	CRO	O3-C3-CA3	-2.50	118.86	126.39
1	A	277	CRO	C1-CA1-N1	-2.44	106.01	109.96
1	A	277	CRO	CD2-CG2-CD1	2.31	121.06	117.64

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	277	CRO	C2-CA2-CB2-CG2
1	A	277	CRO	N2-CA2-CB2-CG2

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

5.6 Ligand geometry [i](#)

5 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	EDO	A	1004	-	3,3,3	0.47	0	2,2,2	0.49	0
2	EDO	A	1005	-	3,3,3	0.55	0	2,2,2	0.30	0
2	EDO	A	1003	-	3,3,3	0.43	0	2,2,2	0.64	0
2	EDO	A	1002	-	3,3,3	0.45	0	2,2,2	1.03	0
2	EDO	A	1001	-	3,3,3	0.55	0	2,2,2	0.32	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
2	EDO	A	1004	-	-	0/1/1/1	-
2	EDO	A	1005	-	-	1/1/1/1	-
2	EDO	A	1003	-	-	1/1/1/1	-
2	EDO	A	1002	-	-	1/1/1/1	-
2	EDO	A	1001	-	-	0/1/1/1	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	1005	EDO	O1-C1-C2-O2
2	A	1003	EDO	O1-C1-C2-O2
2	A	1002	EDO	O1-C1-C2-O2

There are no ring outliers.

No monomer is involved in short contacts.

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, 95th 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 ²)	Q<0.9
1	A	506/555 (91%)	0.43	65 (12%) 3 4	23, 35, 90, 105	0

All (65) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	407	LEU	8.1
1	A	360	GLY	7.3
1	A	428	PHE	6.6
1	A	402	ALA	6.3
1	A	404	GLN	6.2
1	A	466	VAL	5.9
1	A	403	LYS	5.7
1	A	454	ALA	5.5
1	A	450	LYS	5.4
1	A	453	ASP	5.1
1	A	464	ASN	5.0
1	A	486	LEU	5.0
1	A	455	GLY	4.9
1	A	359	PRO	4.8
1	A	400	GLU	4.7
1	A	451	SER	4.7
1	A	426	MET	4.7
1	A	482	LYS	4.5
1	A	448	HIS	4.5
1	A	430	GLU	4.5
1	A	38	ASN	4.4
1	A	429	LEU	4.3
1	A	479	VAL	4.3
1	A	401	LEU	4.3
1	A	456	ILE	4.3
1	A	395	LEU	4.3
1	A	427	MET	4.2

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	A	463	ASN	4.0
1	A	469	ILE	4.0
1	A	425	ASN	3.9
1	A	411	SER	3.9
1	A	419	LYS	3.7
1	A	452	MET	3.6
1	A	418	ASP	3.6
1	A	458	TYR	3.5
1	A	485	ILE	3.5
1	A	468	VAL	3.5
1	A	465	GLU	3.4
1	A	421	ILE	3.3
1	A	447	LYS	3.3
1	A	362	THR	3.3
1	A	443	ASN	3.2
1	A	433	ASP	3.2
1	A	444	PHE	3.1
1	A	446	PHE	2.8
1	A	210	GLY	2.8
1	A	211	SER	2.7
1	A	397	VAL	2.7
1	A	361	ALA	2.5
1	A	393	TYR	2.4
1	A	414	ALA	2.4
1	A	409	THR	2.4
1	A	79	VAL	2.3
1	A	439	GLN	2.3
1	A	406	ASN	2.3
1	A	487	GLU	2.3
1	A	483	LEU	2.2
1	A	538	GLY	2.2
1	A	405	TYR	2.1
1	A	432	PRO	2.1
1	A	467	GLN	2.1
1	A	445	LYS	2.1
1	A	457	PRO	2.1
1	A	462	ASP	2.0
1	A	420	LEU	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [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, 95th 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(Å ²)	Q<0.9
1	CRO	A	277	22/23	0.97	0.12	21,26,31,35	0

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, 95th 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(Å ²)	Q<0.9
2	EDO	A	1001	4/4	0.82	0.14	37,41,43,44	0
2	EDO	A	1005	4/4	0.86	0.10	44,51,51,56	0
2	EDO	A	1004	4/4	0.89	0.09	48,49,49,51	0
2	EDO	A	1002	4/4	0.94	0.17	42,44,45,46	0
2	EDO	A	1003	4/4	0.97	0.11	34,35,47,54	0

6.5 Other polymers [i](#)

There are no such residues in this entry.