



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 13, 2017 – 05:13 am GMT

PDB ID : 2XN6  
Title : CRYSTAL STRUCTURE OF THYROXINE-BINDING GLOBULIN COM-  
PLEXED WITH THYROXINE-FLUORESEIN  
Authors : Qi, X.; Yan, Y.; Wei, Z.; Zhou, A.  
Deposited on : 2010-07-30  
Resolution : 1.29 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 : 1.7.2 (RC1), CSD as538be (2017)  
Xtriage (Phenix) : 1.9-1692  
EDS : trunk28620  
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)  
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) : recalc28949

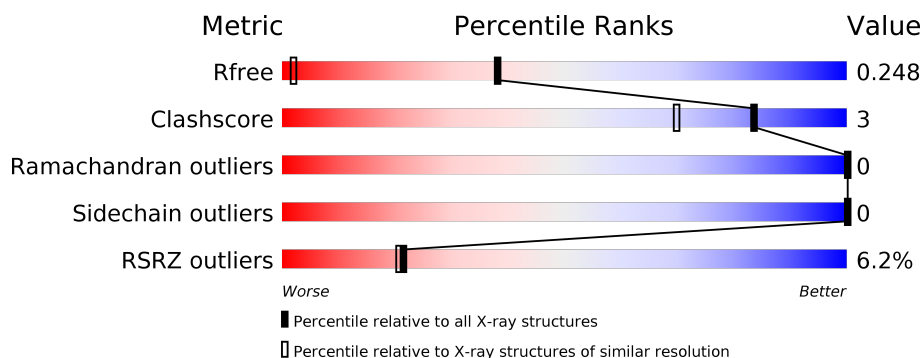
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 1.29 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))
$R_{free}$	100719	1131 (1.32-1.28)
Clashscore	112137	1185 (1.32-1.28)
Ramachandran outliers	110173	1138 (1.32-1.28)
Sidechain outliers	110143	1138 (1.32-1.28)
RSRZ outliers	101464	1133 (1.32-1.28)

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	350	
2	B	35	

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
3	CA	A	1368	-	-	-	X
4	EDO	A	1357	-	-	-	X
4	EDO	A	1360	-	-	-	X
4	EDO	A	1361	-	-	-	X
4	EDO	A	1363	-	-	-	X
4	EDO	B	1396	-	-	-	X
5	F6Y	A	1369	-	-	-	X

## 2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 3388 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 THYROXINE-BINDING GLOBULIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	338	Total	C	N	O	S	0	12	1
			2714	1750	436	508	20			

There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	222	ASP	GLU	CONFLICT	UNP P05543
A	346	GLY	ALA	ENGINEERED MUTATION	UNP P05543
A	347	ALA	VAL	ENGINEERED MUTATION	UNP P05543
A	348	MET	PRO	ENGINEERED MUTATION	UNP P05543
A	349	PHE	GLU	ENGINEERED MUTATION	UNP P05543
A	350	LEU	VAL	ENGINEERED MUTATION	UNP P05543
A	351	GLU	GLU	ENGINEERED MUTATION	UNP P05543
A	352	ALA	LEU	ENGINEERED MUTATION	UNP P05543
A	353	ILE	SER	ENGINEERED MUTATION	UNP P05543
A	354	PRO	ASP	ENGINEERED MUTATION	UNP P05543
A	355	ARG	GLN	ENGINEERED MUTATION	UNP P05543
A	356	SER	PRO	ENGINEERED MUTATION	UNP P05543
A	357	ILE	GLU	ENGINEERED MUTATION	UNP P05543
A	358	PRO	-	INSERTION	UNP P05543

- Molecule 2 is a protein called THYROXINE-BINDING GLOBULIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	34	Total	C	N	O	S	0	2	0
			283	185	48	49	1			

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

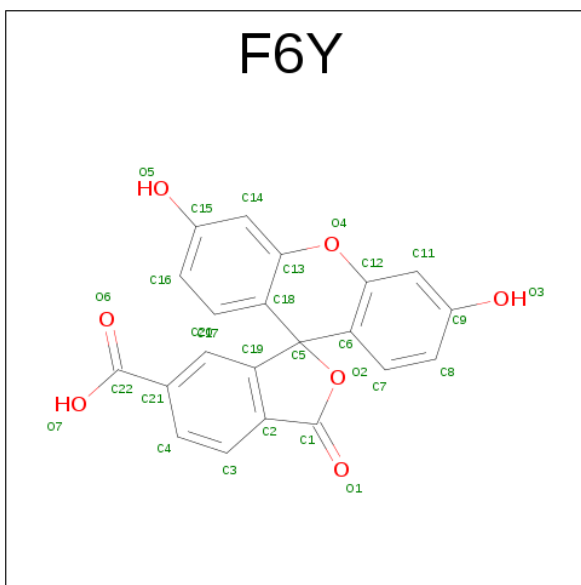
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	7	Total	Ca	0	0
			7	7		

- Molecule 4 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula:  $C_2H_6O_2$ ).



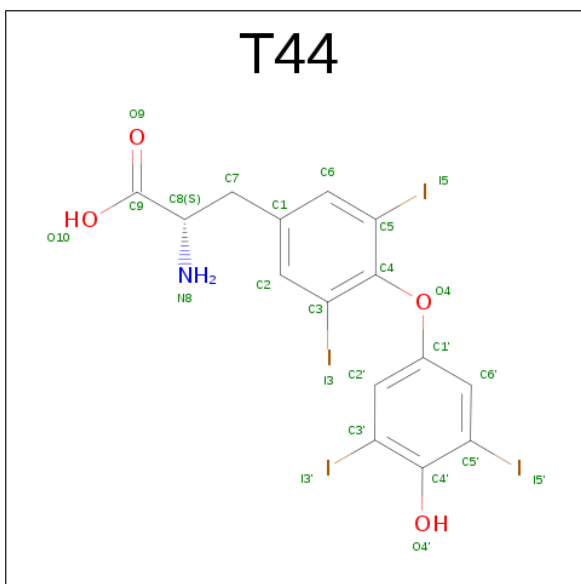
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		
4	B	1	Total	C	O	0	0
			4	2	2		

- Molecule 5 is 3',6'-DIHYDROXY-3-OXO-3H-SPIRO[2-BENZOFURAN-1,9'-XANTHENE]-6-CARBOXYLIC ACID (three-letter code: F6Y) (formula:  $C_{21}H_{12}O_7$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			27	21	6		

- Molecule 6 is 3,5,3',5'-TETRAIODO-L-THYRONINE (three-letter code: T44) (formula:  $C_{15}H_{11}I_4NO_4$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
6	A	1	Total	C	I	N	O	
			24	15	4	1	4	0

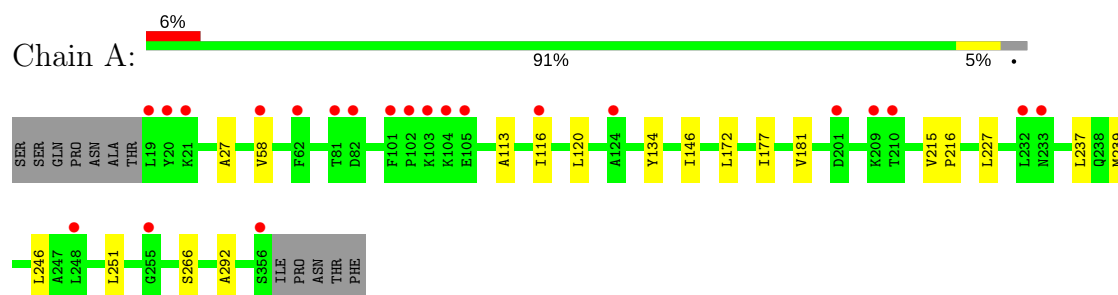
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	287	Total 287	O 287	0	0
7	B	18	Total 18	O 18	0	0

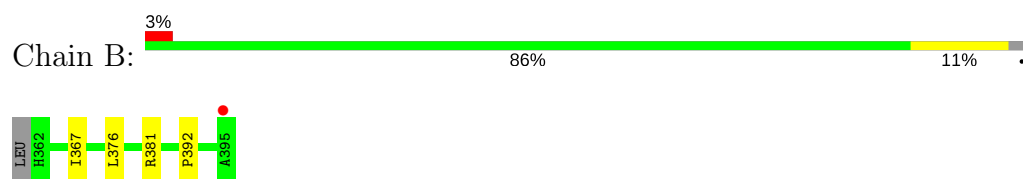
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of 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: THYROXINE-BINDING GLOBULIN



#### • Molecule 2: THYROXINE-BINDING GLOBULIN





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	172.69Å 42.14Å 56.10Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	86.34 – 1.29 28.05 – 1.29	Depositor EDS
% Data completeness (in resolution range)	95.9 (86.34-1.29) 95.9 (28.05-1.29)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.07 (at 1.28Å)	Xtriage
Refinement program	REFMAC 5.5.0072	Depositor
R, $R_{free}$	0.207 , 0.235 0.223 , 0.248	Depositor DCC
$R_{free}$ test set	4994 reflections (5.26%)	DCC
Wilson B-factor (Å <sup>2</sup> )	13.2	Xtriage
Anisotropy	0.426	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.46 , 59.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	3388	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	17.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.78% 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: CA, EDO, F6Y, T44

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	0.34	0/2802	0.53	0/3792
2	B	0.35	0/293	0.60	0/394
All	All	0.34	0/3095	0.54	0/4186

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	2714	0	2737	16	0
2	B	283	0	310	4	0
3	A	7	0	0	0	0
4	A	24	0	36	1	0
4	B	4	0	6	0	0
5	A	27	0	9	0	0
6	A	24	0	8	2	0
7	A	287	0	0	0	0
7	B	18	0	0	0	0
All	All	3388	0	3106	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 3.

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:A:246:LEU:HD11	2:B:376:LEU:HD12	1.65	0.77
1:A:246:LEU:HD21	6:A:1370:T44:C2	2.30	0.60
1:A:113:ALA:HB3	1:A:181:VAL:CG2	2.40	0.51
1:A:120:LEU:HD21	1:A:177:ILE:HD12	1.92	0.51
1:A:215[A]:VAL:HG11	2:B:392:PRO:HG2	1.93	0.49
1:A:27:ALA:HB3	1:A:266[B]:SER:OG	2.12	0.49
1:A:116:ILE:CD1	1:A:120:LEU:HD12	2.44	0.47
1:A:215[B]:VAL:HG22	1:A:216:PRO:HD2	1.97	0.46
1:A:58[A]:VAL:CG1	1:A:134:TYR:OH	2.64	0.46
1:A:227:LEU:C	1:A:227:LEU:HD12	2.36	0.46
1:A:292:ALA:HB1	4:A:1363:EDO:H12	1.99	0.45
6:A:1370:T44:I3	2:B:381:ARG:HA	2.87	0.45
1:A:116:ILE:HD12	1:A:120:LEU:HD12	2.00	0.43
1:A:251:LEU:HD22	2:B:367[A]:ILE:HD13	2.01	0.42
1:A:146:ILE:CD1	1:A:172:LEU:HD23	2.49	0.42
1:A:237:LEU:HD13	1:A:239[B]:MET:HG3	2.00	0.42
1:A:146:ILE:HD11	1:A:172:LEU:HG	2.04	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles ⓘ

### 5.3.1 Protein backbone ⓘ

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	348/350 (99%)	344 (99%)	4 (1%)	0	100	100
2	B	34/35 (97%)	32 (94%)	2 (6%)	0	100	100
All	All	382/385 (99%)	376 (98%)	6 (2%)	0	100	100

There are no Ramachandran outliers to report.

### 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	307/307 (100%)	307 (100%)	0	100	100
2	B	34/33 (103%)	34 (100%)	0	100	100
All	All	341/340 (100%)	341 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	214	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](#)

Of 16 ligands modelled in this entry, 7 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	$\# Z  > 2$
4	EDO	A	1357	-	3,3,3	0.48	0	2,2,2	0.20	0
4	EDO	A	1358	-	3,3,3	0.48	0	2,2,2	0.28	0
4	EDO	A	1360	-	3,3,3	0.42	0	2,2,2	0.41	0
4	EDO	A	1361	-	3,3,3	0.43	0	2,2,2	0.55	0
4	EDO	A	1363	-	3,3,3	0.38	0	2,2,2	0.39	0
4	EDO	A	1364	-	3,3,3	0.43	0	2,2,2	0.33	0
5	F6Y	A	1369	6	31,31,32	1.23	2 (6%)	47,48,50	1.79	16 (34%)
6	T44	A	1370	5	21,25,25	0.40	0	31,36,36	0.61	0
4	EDO	B	1396	-	3,3,3	0.42	0	2,2,2	0.41	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
4	EDO	A	1357	-	-	0/1/1/1	0/0/0/0
4	EDO	A	1358	-	-	0/1/1/1	0/0/0/0
4	EDO	A	1360	-	-	0/1/1/1	0/0/0/0
4	EDO	A	1361	-	-	0/1/1/1	0/0/0/0
4	EDO	A	1363	-	-	0/1/1/1	0/0/0/0
4	EDO	A	1364	-	-	0/1/1/1	0/0/0/0
5	F6Y	A	1369	6	-	0/2/33/35	0/5/5/5
6	T44	A	1370	5	-	0/8/12/12	0/2/2/2
4	EDO	B	1396	-	-	0/1/1/1	0/0/0/0

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	1369	F6Y	O2-C5	-2.80	1.44	1.50
5	A	1369	F6Y	O2-C1	5.45	1.46	1.36

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	1369	F6Y	O4-C12-C6	-3.50	119.70	122.77
5	A	1369	F6Y	O4-C13-C18	-3.39	119.80	122.77
5	A	1369	F6Y	C19-C5-C6	-2.73	109.17	113.50
5	A	1369	F6Y	C19-C5-C18	-2.58	109.40	113.50

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	1369	F6Y	C5-C18-C13	-2.26	119.22	121.57
5	A	1369	F6Y	C4-C3-C2	-2.15	117.58	121.01
5	A	1369	F6Y	C5-C6-C12	-2.09	119.40	121.57
5	A	1369	F6Y	O2-C5-C6	2.19	111.25	107.75
5	A	1369	F6Y	O2-C5-C18	2.45	111.66	107.75
5	A	1369	F6Y	C17-C18-C13	2.48	119.55	116.60
5	A	1369	F6Y	C5-C19-C2	2.49	112.22	110.09
5	A	1369	F6Y	O2-C5-C19	2.55	103.72	101.66
5	A	1369	F6Y	C7-C6-C12	2.55	119.63	116.60
5	A	1369	F6Y	O4-C13-C14	3.04	119.81	115.22
5	A	1369	F6Y	O4-C12-C11	3.12	119.93	115.22
5	A	1369	F6Y	O2-C1-O1	3.89	125.73	121.14

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
4	A	1363	EDO	1	0
6	A	1370	T44	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	338/350 (96%)	0.50	22 (6%)	20 19	8, 16, 26, 38	6 (1%)
2	B	34/35 (97%)	0.71	1 (2%)	52 50	8, 13, 24, 31	0
All	All	372/385 (96%)	0.52	23 (6%)	21 21	8, 16, 26, 38	6 (1%)

All (23) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	20	TYR	10.0
2	B	395	ALA	8.7
1	A	19	LEU	7.1
1	A	81	THR	5.6
1	A	21	LYS	4.4
1	A	356	SER	4.3
1	A	255	GLY	3.9
1	A	101	PHE	3.6
1	A	105	GLU	3.5
1	A	124	ALA	3.4
1	A	233[A]	ASN	3.2
1	A	248[A]	LEU	3.1
1	A	104	LYS	2.8
1	A	82	ASP	2.8
1	A	58[A]	VAL	2.7
1	A	103	LYS	2.6
1	A	232	LEU	2.6
1	A	209	LYS	2.2
1	A	116	ILE	2.1
1	A	210	THR	2.1
1	A	201	ASP	2.1
1	A	62	PHE	2.0
1	A	102	PRO	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(Å <sup>2</sup> )	Q<0.9
4	EDO	A	1363	4/4	0.89	0.17	10.05	29,29,29,29	0
4	EDO	A	1360	4/4	0.86	0.18	7.29	15,21,21,23	0
5	F6Y	A	1369	27/28	0.38	0.60	5.08	32,38,39,39	27
4	EDO	A	1357	4/4	0.37	0.23	4.52	33,33,34,34	0
3	CA	A	1368	1/1	0.64	0.19	3.41	73,73,73,73	0
4	EDO	B	1396	4/4	0.81	0.16	2.97	21,24,24,25	0
4	EDO	A	1361	4/4	0.74	0.18	2.69	22,23,24,25	0
4	EDO	A	1364	4/4	0.88	0.10	1.64	32,32,32,32	0
4	EDO	A	1358	4/4	0.84	0.10	1.20	21,23,24,26	0
6	T44	A	1370	24/24	0.99	0.11	0.23	15,18,28,30	24
3	CA	A	1359	1/1	0.85	0.11	-0.03	19,19,19,19	1
3	CA	A	1362	1/1	0.98	0.05	-1.72	28,28,28,28	0
3	CA	A	1367	1/1	0.84	0.04	-	59,59,59,59	0
3	CA	A	1356	1/1	0.92	0.06	-	38,38,38,38	0
3	CA	A	1365	1/1	0.09	0.24	-	86,86,86,86	0
3	CA	A	1366	1/1	0.46	0.13	-	67,67,67,67	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.