



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 07:03 AM GMT

PDB ID : 2Z00  
Title : Crystal structure of dihydroorotase from *Thermus thermophilus*  
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Deposited on : 2007-05-06  
Resolution : 2.42 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

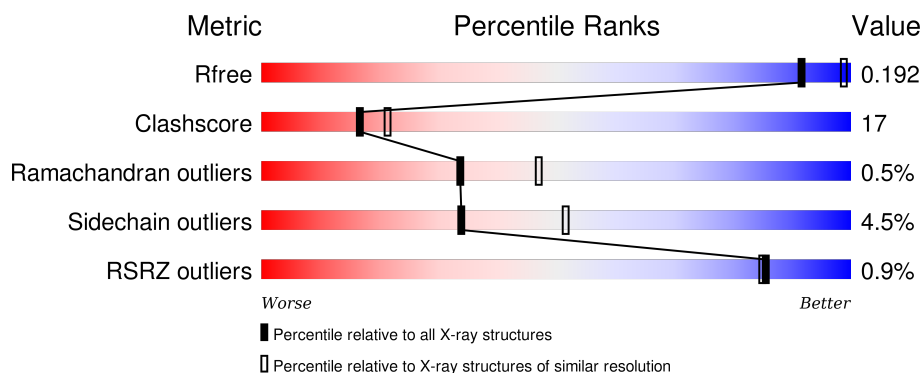
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.42 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	3386 (2.44-2.40)
Clashscore	102246	3897 (2.44-2.40)
Ramachandran outliers	100387	3837 (2.44-2.40)
Sidechain outliers	100360	3838 (2.44-2.40)
RSRZ outliers	91569	3396 (2.44-2.40)

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	426	<div> <div></div> <div>74%</div> <div>22%</div> <div>..</div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3619 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 Dihydroorotase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	426	Total	C	N	O	S	Se	0	0	0
			3224	2046	581	592	1	4			

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Zn	0	0
			2	2		

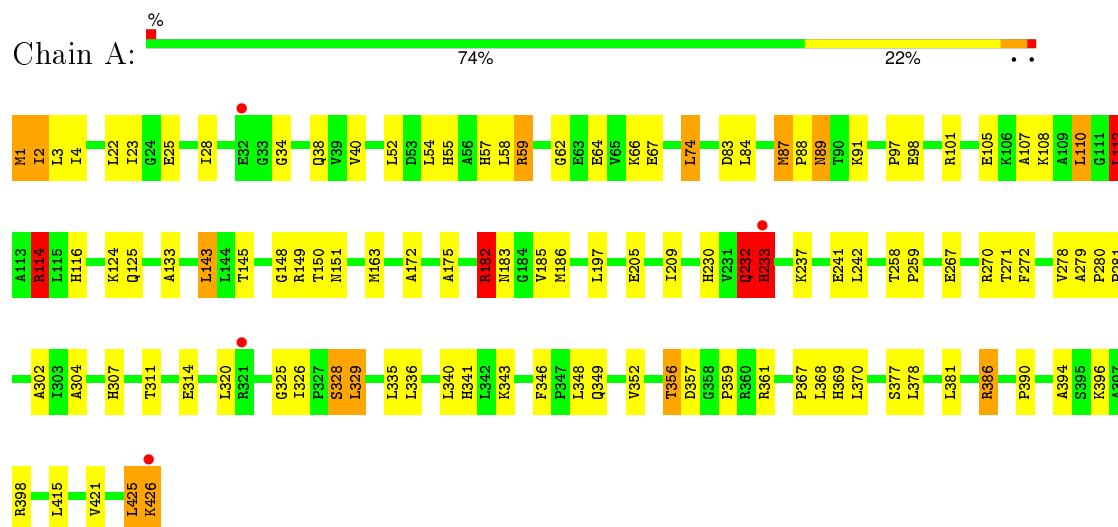
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	393	Total	O	0	0
			393	393		

### 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 ( $\text{RSRZ} > 2$ ). 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: Dihydroorotase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 65 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	129.94Å 129.94Å 209.91Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	43.85 – 2.42 49.59 – 2.42	Depositor EDS
% Data completeness (in resolution range)	98.5 (43.85-2.42) 98.7 (49.59-2.42)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	11.82 (at 2.42Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, $R_{free}$	0.188 , 0.192 0.188 , 0.192	Depositor DCC
$R_{free}$ test set	4017 reflections (10.06%)	DCC
Wilson B-factor (Å <sup>2</sup> )	21.5	Xtriage
Anisotropy	0.465	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.39 , 55.4	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Outliers	0 of 40438 reflections	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	3619	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	22.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.09% 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

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: ZN

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	1/3288 (0.0%)	0.85	22/4468 (0.5%)

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	8

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	1	MSE	CG-SE	-5.02	1.78	1.95

All (22) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	425	LEU	O-C-N	-10.12	106.51	122.70
1	A	233	HIS	O-C-N	-9.76	107.09	122.70
1	A	149	ARG	O-C-N	8.49	136.28	122.70
1	A	148	GLY	N-CA-C	-7.80	93.59	113.10
1	A	149	ARG	C-N-CA	-7.45	103.08	121.70
1	A	233	HIS	CA-C-O	-7.03	105.35	120.10
1	A	150	THR	CA-C-N	6.84	132.25	117.20
1	A	425	LEU	CA-C-N	6.74	132.03	117.20
1	A	149	ARG	CA-C-N	-6.71	102.45	117.20
1	A	233	HIS	CA-C-N	6.49	131.48	117.20
1	A	182	ARG	C-N-CA	-6.46	105.56	121.70
1	A	426	LYS	CB-CA-C	-6.45	97.51	110.40

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	58	LEU	O-C-N	-6.28	112.66	122.70
1	A	182	ARG	NE-CZ-NH1	-6.02	117.29	120.30
1	A	112	LEU	O-C-N	-5.94	113.19	122.70
1	A	232	GLN	C-N-CA	-5.63	107.62	121.70
1	A	150	THR	O-C-N	-5.53	113.84	122.70
1	A	87	MSE	CB-CA-C	5.32	121.04	110.40
1	A	183	ASN	CB-CA-C	5.32	121.04	110.40
1	A	182	ARG	NE-CZ-NH2	5.30	122.95	120.30
1	A	114	ARG	CB-CA-C	5.30	121.00	110.40
1	A	343	LYS	CB-CA-C	5.30	120.99	110.40

There are no chirality outliers.

All (8) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	107	ALA	Mainchain
1	A	112	LEU	Mainchain
1	A	182	ARG	Sidechain
1	A	232	GLN	Mainchain
1	A	233	HIS	Mainchain
1	A	356	THR	Mainchain
1	A	425	LEU	Peptide
1	A	59	ARG	Mainchain

## 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	3224	0	3314	108	0
2	A	2	0	0	0	0
3	A	393	0	0	17	0
All	All	3619	0	3314	108	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 17.

All (108) 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:108:LYS:HE2	3:A:1363:HOH:O	1.42	1.18
1:A:233:HIS:CE1	1:A:280:PRO:HD3	1.89	1.07
1:A:28:ILE:HD11	1:A:378:LEU:HD11	1.44	1.00
1:A:278:VAL:HB	1:A:326:ILE:HD13	1.47	0.95
1:A:205:GLU:O	1:A:209:ILE:HD13	1.66	0.94
1:A:4:ILE:HD13	1:A:40:VAL:HB	1.53	0.90
1:A:205:GLU:O	1:A:209:ILE:CD1	2.21	0.89
1:A:2:ILE:HD13	1:A:3:LEU:N	1.88	0.87
1:A:278:VAL:HB	1:A:326:ILE:CD1	2.09	0.83
1:A:91:LYS:HE3	3:A:1203:HOH:O	1.83	0.79
1:A:356:THR:OG1	1:A:357:ASP:N	2.18	0.75
1:A:67:GLU:OE2	1:A:307:HIS:HE1	1.69	0.75
1:A:57:HIS:HD1	1:A:89:ASN:HD21	1.32	0.74
1:A:325:GLY:C	1:A:326:ILE:HD12	2.09	0.73
1:A:232:GLN:O	1:A:233:HIS:C	2.27	0.72
1:A:352:VAL:O	1:A:356:THR:HG23	1.89	0.71
1:A:233:HIS:CE1	1:A:280:PRO:CD	2.70	0.70
1:A:25:GLU:HG2	3:A:1257:HOH:O	1.93	0.68
1:A:2:ILE:HD13	1:A:3:LEU:H	1.58	0.67
1:A:2:ILE:HD11	1:A:40:VAL:HG23	1.78	0.65
1:A:271:THR:HB	3:A:1376:HOH:O	1.95	0.65
1:A:278:VAL:CB	1:A:326:ILE:HD13	2.27	0.64
1:A:361:ARG:HH12	1:A:367:PRO:HB3	1.62	0.63
1:A:23:ILE:HG12	1:A:28:ILE:HD13	1.81	0.63
1:A:307:HIS:HD2	1:A:328:SER:H	1.47	0.63
1:A:2:ILE:HG12	1:A:38:GLN:HG2	1.82	0.61
1:A:205:GLU:O	1:A:209:ILE:HD12	1.99	0.60
1:A:59:ARG:HG3	1:A:66:LYS:HB2	1.82	0.60
1:A:64:GLU:HA	1:A:67:GLU:O	2.01	0.60
1:A:83:ASP:CG	1:A:114:ARG:HH21	2.05	0.59
1:A:237:LYS:O	1:A:241:GLU:HG3	2.03	0.59
1:A:307:HIS:HD2	1:A:329:LEU:H	1.51	0.58
1:A:133:ALA:HB2	1:A:163:MSE:HE3	1.85	0.58
1:A:182:ARG:HG2	1:A:182:ARG:HH11	1.68	0.58
1:A:101:ARG:O	1:A:105:GLU:HG3	2.04	0.58
1:A:182:ARG:HD2	3:A:1275:HOH:O	2.05	0.56
1:A:2:ILE:HG22	1:A:23:ILE:HB	1.88	0.56
1:A:311:THR:OG1	1:A:314:GLU:HG3	2.05	0.56
1:A:83:ASP:OD1	1:A:116:HIS:HE1	1.89	0.55
1:A:271:THR:HA	3:A:1377:HOH:O	2.04	0.55
1:A:271:THR:HG22	1:A:271:THR:O	2.05	0.55
1:A:270:ARG:HD2	3:A:1298:HOH:O	2.06	0.55

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:55:HIS:CD2	1:A:87:MSE:SE	3.11	0.54
1:A:307:HIS:CD2	1:A:328:SER:H	2.26	0.54
1:A:83:ASP:OD2	1:A:114:ARG:NH2	2.31	0.54
1:A:390:PRO:O	1:A:398:ARG:HD2	2.09	0.53
1:A:89:ASN:N	1:A:89:ASN:HD22	2.07	0.52
1:A:281:PRO:HG3	3:A:1143:HOH:O	2.10	0.52
1:A:349:GLN:HG2	3:A:1223:HOH:O	2.10	0.51
1:A:259:PRO:HD2	3:A:1294:HOH:O	2.10	0.51
1:A:143:LEU:HD12	1:A:143:LEU:C	2.29	0.51
1:A:98:GLU:CD	1:A:98:GLU:H	2.13	0.51
1:A:341:HIS:HD2	1:A:346:PHE:O	1.93	0.51
1:A:325:GLY:O	1:A:326:ILE:HD12	2.10	0.51
1:A:267:GLU:O	1:A:270:ARG:HG3	2.11	0.51
1:A:361:ARG:HH11	1:A:361:ARG:HG3	1.76	0.51
1:A:233:HIS:ND1	1:A:280:PRO:CD	2.74	0.50
1:A:151:ASN:ND2	3:A:1034:HOH:O	2.45	0.50
1:A:2:ILE:HD12	1:A:4:ILE:CD1	2.43	0.49
1:A:233:HIS:CG	1:A:280:PRO:HD2	2.47	0.49
1:A:175:ALA:HB1	1:A:209:ILE:HD12	1.94	0.48
1:A:302:ALA:HB1	1:A:359:PRO:HG3	1.95	0.48
1:A:307:HIS:CD2	1:A:329:LEU:H	2.30	0.48
1:A:271:THR:O	1:A:272:PHE:HB2	2.14	0.48
1:A:4:ILE:CD1	1:A:40:VAL:HB	2.34	0.47
1:A:59:ARG:NH1	3:A:1078:HOH:O	2.42	0.47
1:A:271:THR:HG21	3:A:1378:HOH:O	2.15	0.47
1:A:271:THR:HG22	3:A:1165:HOH:O	2.15	0.46
1:A:89:ASN:H	1:A:89:ASN:HD22	1.62	0.46
1:A:28:ILE:CD1	1:A:378:LEU:HD11	2.30	0.46
1:A:377:SER:HA	1:A:415:LEU:O	2.16	0.46
1:A:88:PRO:HG2	1:A:125:GLN:NE2	2.31	0.46
1:A:22:LEU:HD22	1:A:34:GLY:HA3	1.96	0.46
1:A:62:GLY:HA3	1:A:91:LYS:HB2	1.98	0.46
1:A:278:VAL:HG22	1:A:279:ALA:N	2.31	0.46
1:A:59:ARG:H	1:A:59:ARG:HD3	1.81	0.45
1:A:57:HIS:HB3	1:A:59:ARG:NH1	2.30	0.45
1:A:336:LEU:O	1:A:340:LEU:HB2	2.15	0.45
1:A:52:LEU:HD23	1:A:52:LEU:C	2.36	0.45
1:A:97:PRO:HD2	1:A:98:GLU:OE2	2.17	0.45
1:A:84:LEU:C	1:A:84:LEU:HD23	2.37	0.43
1:A:356:THR:C	1:A:359:PRO:HD2	2.39	0.43
1:A:398:ARG:HG2	1:A:398:ARG:HH11	1.83	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:112:LEU:HD23	1:A:421:VAL:HB	2.00	0.43
1:A:357:ASP:OD2	1:A:369:HIS:HE1	2.01	0.43
1:A:59:ARG:HG3	1:A:66:LYS:CB	2.49	0.43
1:A:114:ARG:HE	1:A:114:ARG:HB2	1.70	0.42
1:A:381:LEU:N	1:A:381:LEU:HD22	2.35	0.42
1:A:205:GLU:C	1:A:209:ILE:HD13	2.37	0.42
1:A:396:LYS:HA	1:A:398:ARG:NH1	2.34	0.42
1:A:398:ARG:NH2	3:A:1330:HOH:O	2.52	0.42
1:A:182:ARG:HH11	1:A:182:ARG:CG	2.32	0.41
1:A:386:ARG:HD3	3:A:1322:HOH:O	2.19	0.41
1:A:233:HIS:ND1	1:A:280:PRO:HD3	2.25	0.41
1:A:59:ARG:HB2	1:A:67:GLU:HB3	2.02	0.41
1:A:370:LEU:CD2	1:A:378:LEU:HD22	2.50	0.41
1:A:74:LEU:HD13	1:A:394:ALA:HB1	2.03	0.41
1:A:110:LEU:HD12	1:A:110:LEU:HA	1.89	0.41
1:A:185:VAL:HG11	1:A:320:LEU:HD23	2.03	0.41
1:A:172:ALA:HA	1:A:230:HIS:O	2.20	0.41
1:A:87:MSE:CE	1:A:145:THR:HG21	2.50	0.41
1:A:278:VAL:CG2	1:A:326:ILE:HD13	2.50	0.40
1:A:205:GLU:HG2	1:A:209:ILE:HD13	2.03	0.40
1:A:67:GLU:OE2	1:A:307:HIS:CE1	2.60	0.40
1:A:270:ARG:HB2	3:A:1300:HOH:O	2.20	0.40
1:A:186:MSE:SE	1:A:197:LEU:HD12	2.71	0.40
1:A:1:MSE:HA	1:A:23:ILE:O	2.21	0.40
1:A:258:THR:HA	1:A:304:ALA:O	2.21	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	424/426 (100%)	402 (95%)	20 (5%)	2 (0%)	34	47

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	233	HIS
1	A	328	SER

### 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	332/328 (101%)	317 (96%)	15 (4%)	34 51

All (15) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	2	ILE
1	A	54	LEU
1	A	74	LEU
1	A	89	ASN
1	A	110	LEU
1	A	114	ARG
1	A	124	LYS
1	A	143	LEU
1	A	242	LEU
1	A	329	LEU
1	A	335	LEU
1	A	348	LEU
1	A	368	LEU
1	A	386	ARG
1	A	426	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	89	ASN
1	A	116	HIS
1	A	151	ASN

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Mol	Chain	Res	Type
1	A	307	HIS
1	A	341	HIS
1	A	369	HIS

### 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 carbohydrates in this entry.

### 5.6 Ligand geometry ⓘ

Of 2 ligands modelled in this entry, 2 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

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 [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

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	422/426 (99%)	-0.63	4 (0%) 85 85	12, 19, 32, 42	0

All (4) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	426	LYS	2.9
1	A	32	GLU	2.4
1	A	233	HIS	2.3
1	A	321	ARG	2.2

### 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
2	ZN	A	1006	1/1	0.97	0.30	1.96	1,1,1,1	1
2	ZN	A	1004	1/1	0.98	0.25	-	1,1,1,1	1

## 6.5 Other polymers

There are no such residues in this entry.