



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 01:45 PM UTC

PDB ID : 7XLO / pdb_00007xlo
Title : Crystal Structure of the Catalytic Domain of Inosine Monophosphate Dehydrogenase (IMPDH) from Methanocaldococcus jannaschii
Authors : Bellur, A.; Sharma, P.; Balaram, H.
Deposited on : 2022-04-22
Resolution : 2.60 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	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

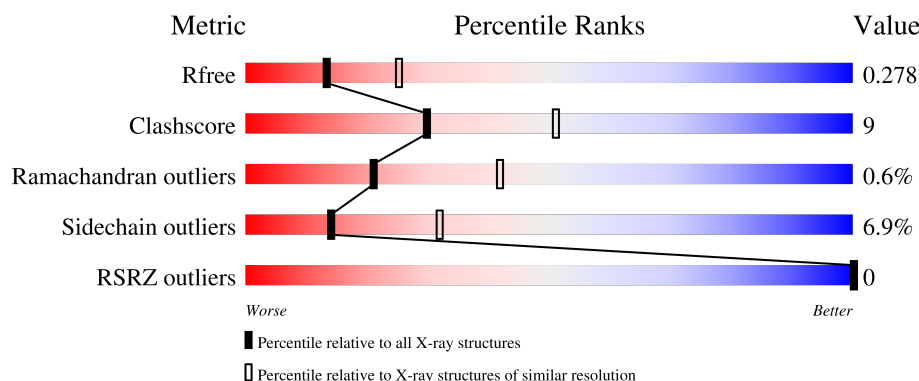
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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}	180053	4008 (2.60-2.60)
Clashscore	190562	4347 (2.60-2.60)
Ramachandran outliers	187476	4277 (2.60-2.60)
Sidechain outliers	187428	4277 (2.60-2.60)
RSRZ outliers	180081	4008 (2.60-2.60)

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	398	
1	B	398	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 4921 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 Inosine-5'-monophosphate dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	326	Total	C	N	O	S	0	0	0
			2387	1510	414	449	14			
1	B	324	Total	C	N	O	S	0	0	0
			2369	1497	409	449	14			

There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	98	GLY	-	linker	UNP Q59011
A	99	SER	-	linker	UNP Q59011
A	100	GLY	-	linker	UNP Q59011
A	101	GLY	-	linker	UNP Q59011
A	391	LEU	-	expression tag	UNP Q59011
A	392	GLU	-	expression tag	UNP Q59011
A	393	HIS	-	expression tag	UNP Q59011
A	394	HIS	-	expression tag	UNP Q59011
A	395	HIS	-	expression tag	UNP Q59011
A	396	HIS	-	expression tag	UNP Q59011
A	397	HIS	-	expression tag	UNP Q59011
A	398	HIS	-	expression tag	UNP Q59011
B	98	GLY	-	linker	UNP Q59011
B	99	SER	-	linker	UNP Q59011
B	100	GLY	-	linker	UNP Q59011
B	101	GLY	-	linker	UNP Q59011
B	391	LEU	-	expression tag	UNP Q59011
B	392	GLU	-	expression tag	UNP Q59011
B	393	HIS	-	expression tag	UNP Q59011
B	394	HIS	-	expression tag	UNP Q59011
B	395	HIS	-	expression tag	UNP Q59011
B	396	HIS	-	expression tag	UNP Q59011
B	397	HIS	-	expression tag	UNP Q59011
B	398	HIS	-	expression tag	UNP Q59011

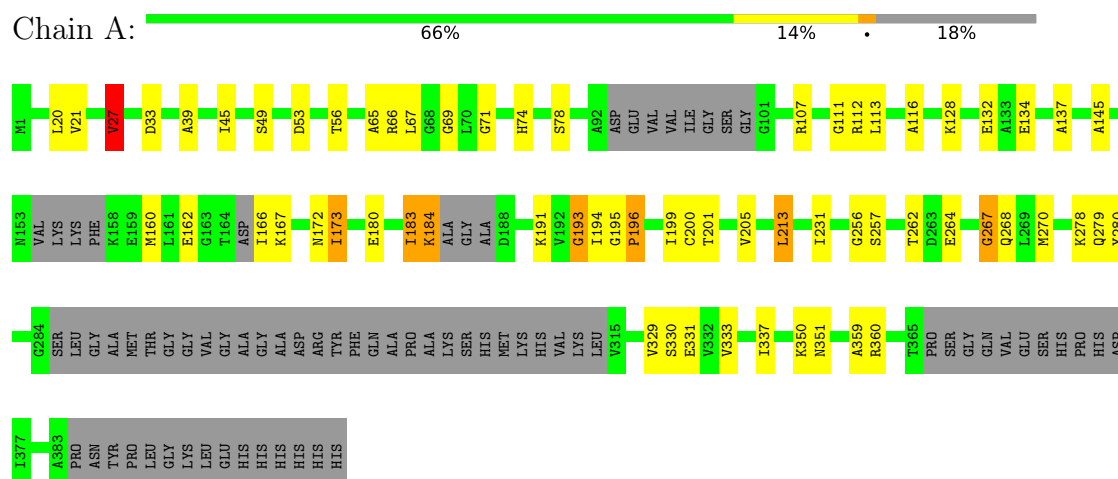
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	86	Total 86	O 86	0	0
2	B	79	Total 79	O 79	0	0

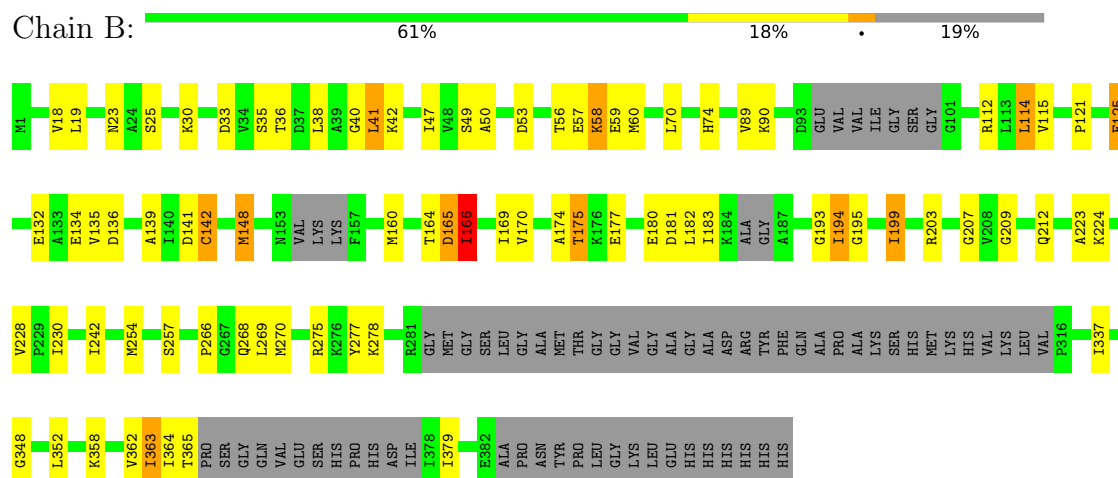
3 Residue-property plots [i](#)

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: Inosine-5'-monophosphate dehydrogenase



- Molecule 1: Inosine-5'-monophosphate dehydrogenase



4 Data and refinement statistics

Property	Value	Source
Space group	I 4	Depositor
Cell constants a, b, c, α , β , γ	97.65Å 97.65Å 168.22Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	53.37 – 2.60 53.37 – 2.60	Depositor EDS
% Data completeness (in resolution range)	100.0 (53.37-2.60) 100.0 (53.37-2.60)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.02 (at 2.61Å)	Xtriage
Refinement program	REFMAC 5.8.0238	Depositor
R, R_{free}	0.254 , 0.276 0.262 , 0.278	Depositor DCC
R_{free} test set	1233 reflections (5.10%)	wwPDB-VP
Wilson B-factor (Å ²)	14.8	Xtriage
Anisotropy	0.543	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 18.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.41$, $\langle L^2 \rangle = 0.23$	Xtriage
Estimated twinning fraction	0.420 for h,-k,-l	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	4921	wwPDB-VP
Average B, all atoms (Å ²)	16.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.28% 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](#)

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	1.00	1/2412 (0.0%)	1.31	3/3255 (0.1%)
1	B	1.00	1/2395 (0.0%)	1.26	6/3237 (0.2%)
All	All	1.00	2/4807 (0.0%)	1.28	9/6492 (0.1%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	196	PRO	C-O	-7.18	1.14	1.24
1	B	125	GLU	CA-C	-5.15	1.46	1.52

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	27	VAL	N-CA-C	7.85	119.78	108.48
1	A	267	GLY	CA-C-N	7.72	133.08	122.19
1	A	267	GLY	C-N-CA	7.72	133.08	122.19
1	B	363	ILE	CA-C-N	6.27	128.98	122.27
1	B	363	ILE	C-N-CA	6.27	128.98	122.27
1	B	175	THR	N-CA-C	6.11	119.66	109.95
1	B	195	GLY	N-CA-C	5.50	123.57	112.34
1	B	242	ILE	CA-C-N	5.05	127.00	120.44
1	B	242	ILE	C-N-CA	5.05	127.00	120.44

There are no chirality outliers.

There are no planarity outliers.

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	2387	0	2445	37	0
1	B	2369	0	2401	45	0
2	A	86	0	0	0	0
2	B	79	0	0	0	0
All	All	4921	0	4846	82	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 9.

All (82) 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:183:ILE:HG13	1:A:184:LYS:HE3	1.44	0.97
1:A:267:GLY:O	1:A:278:LYS:HE2	1.69	0.92
1:A:66:ARG:HG3	1:A:113:LEU:HD11	1.54	0.89
1:B:223:ALA:HB1	1:B:228:VAL:O	1.91	0.71
1:B:194:ILE:HG22	1:B:209:GLY:HA2	1.75	0.67
1:B:53:ASP:HA	1:B:74:HIS:CD2	2.30	0.65
1:A:65:ALA:HA	1:A:69:GLY:O	2.00	0.62
1:B:268:GLN:CB	1:B:278:LYS:HB3	2.30	0.61
1:A:195:GLY:N	1:A:196:PRO:HD2	2.16	0.60
1:B:174:ALA:HB2	1:B:194:ILE:HB	1.84	0.60
1:A:49:SER:HB2	1:A:71:GLY:HA2	1.86	0.58
1:A:264:GLU:OE1	1:A:329:VAL:HG23	2.03	0.58
1:A:267:GLY:O	1:A:278:LYS:CE	2.48	0.57
1:B:49:SER:HB3	1:B:56:THR:OG1	2.06	0.56
1:B:148:MET:HE1	1:B:181:ASP:OD2	2.06	0.56
1:B:58:LYS:HG3	1:B:59:GLU:OE1	2.06	0.55
1:B:121:PRO:HG3	1:B:142:CYS:SG	2.47	0.55
1:B:19:LEU:HD12	1:B:364:ILE:HD11	1.90	0.54
1:B:47:ILE:HD13	1:B:337:ILE:HD11	1.90	0.54
1:B:57:GLU:HG2	1:B:266:PRO:HB3	1.90	0.53
1:A:329:VAL:O	1:A:330:SER:C	2.52	0.53
1:A:39:ALA:O	1:A:167:LYS:HE2	2.10	0.51
1:A:107:ARG:NH1	1:A:111:GLY:O	2.43	0.51
1:B:57:GLU:O	1:B:58:LYS:C	2.55	0.50
1:A:145:ALA:HB3	1:A:173:ILE:HG23	1.95	0.49
1:A:329:VAL:HG12	1:A:333:VAL:HG23	1.94	0.49
1:A:257:SER:CB	1:A:280:TYR:CE2	2.97	0.48
1:B:270:MET:N	1:B:277:TYR:O	2.42	0.48
1:A:201:THR:O	1:A:205:VAL:HG23	2.14	0.48
1:A:257:SER:HB2	1:A:280:TYR:CE2	2.49	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:38:LEU:HB2	1:B:41:LEU:HD12	1.95	0.48
1:B:135:VAL:O	1:B:166:ILE:HG21	2.13	0.48
1:B:57:GLU:H	1:B:60:MET:HB3	1.77	0.47
1:A:194:ILE:C	1:A:196:PRO:HD2	2.39	0.47
1:B:25:SER:CB	1:B:348:GLY:HA2	2.44	0.46
1:B:18:VAL:HG12	1:B:363:ILE:HD13	1.97	0.46
1:B:50:ALA:HA	1:B:254:MET:SD	2.56	0.46
1:A:45:ILE:HB	1:A:337:ILE:HD11	1.97	0.46
1:A:67:LEU:HD21	1:A:330:SER:HA	1.97	0.45
1:B:90:LYS:NZ	1:B:136:ASP:OD1	2.41	0.45
1:A:199:ILE:HD12	1:A:199:ILE:C	2.41	0.45
1:B:203:ARG:O	1:B:207:GLY:HA2	2.16	0.45
1:A:33:ASP:O	1:A:351:ASN:HA	2.17	0.45
1:A:112:ARG:HH22	1:A:134:GLU:CD	2.25	0.45
1:B:38:LEU:C	1:B:40:GLY:N	2.75	0.45
1:B:223:ALA:CB	1:B:230:ILE:HD11	2.47	0.45
1:B:364:ILE:HG22	1:B:365:THR:N	2.32	0.44
1:B:36:THR:HB	1:B:352:LEU:HD12	1.99	0.44
1:A:268:GLN:O	1:A:278:LYS:HA	2.17	0.44
1:B:174:ALA:HB2	1:B:194:ILE:CG1	2.48	0.44
1:A:213:LEU:HD12	1:A:213:LEU:HA	1.81	0.44
1:A:27:VAL:HG11	1:A:350:LYS:HA	2.00	0.43
1:B:70:LEU:HD13	1:B:114:LEU:HD13	1.99	0.43
1:A:162:GLU:OE1	1:A:162:GLU:HA	2.18	0.43
1:B:59:GLU:OE1	1:B:59:GLU:N	2.52	0.43
1:A:172:ASN:HD22	1:A:193:GLY:HA3	1.84	0.43
1:B:49:SER:O	1:B:254:MET:HE2	2.18	0.43
1:B:23:ASN:ND2	1:B:358:LYS:O	2.52	0.43
1:B:38:LEU:C	1:B:40:GLY:H	2.26	0.43
1:B:139:ALA:HA	1:B:169:ILE:HB	2.00	0.42
1:B:165:ASP:OD1	1:B:165:ASP:N	2.51	0.42
1:A:53:ASP:HA	1:A:74:HIS:CD2	2.55	0.42
1:B:90:LYS:HB3	1:B:112:ARG:HD2	2.01	0.42
1:B:132:GLU:C	1:B:134:GLU:H	2.28	0.42
1:B:269:LEU:H	1:B:278:LYS:HA	1.85	0.42
1:A:270:MET:HE1	1:A:279:GLN:HB3	2.01	0.41
1:A:65:ALA:HB3	1:A:113:LEU:HD13	2.01	0.41
1:A:20:LEU:CD2	1:A:359:ALA:HB1	2.49	0.41
1:B:89:VAL:HG11	1:B:115:VAL:HB	2.02	0.41
1:B:174:ALA:HB2	1:B:194:ILE:CB	2.49	0.41
1:B:170:VAL:HG11	1:B:182:LEU:HD22	2.01	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:199:ILE:HD12	1:A:200:CYS:N	2.35	0.41
1:B:177:GLU:O	1:B:180:GLU:HB2	2.21	0.41
1:B:199:ILE:H	1:B:199:ILE:HG13	1.53	0.41
1:A:116:ALA:HB2	1:A:137:ALA:HB3	2.02	0.41
1:B:193:GLY:HA2	1:B:212:GLN:HE22	1.85	0.41
1:A:49:SER:HB3	1:A:56:THR:OG1	2.20	0.41
1:A:262:THR:HG21	1:A:329:VAL:HA	2.03	0.40
1:B:183:ILE:O	1:B:183:ILE:HG23	2.22	0.40
1:A:180:GLU:O	1:A:183:ILE:HG12	2.21	0.40
1:A:191:LYS:HA	1:A:231:ILE:O	2.22	0.40
1:B:33:ASP:OD1	1:B:35:SER:OG	2.31	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	312/398 (78%)	287 (92%)	23 (7%)	2 (1%)	21	42
1	B	312/398 (78%)	283 (91%)	27 (9%)	2 (1%)	21	42
All	All	624/796 (78%)	570 (91%)	50 (8%)	4 (1%)	21	42

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	256	GLY
1	B	166	ILE
1	B	194	ILE
1	A	193	GLY

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	242/305 (79%)	229 (95%)	13 (5%)	20	42
1	B	239/305 (78%)	219 (92%)	20 (8%)	10	23
All	All	481/610 (79%)	448 (93%)	33 (7%)	14	32

All (33) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	21	VAL
1	A	27	VAL
1	A	78	SER
1	A	128	LYS
1	A	132	GLU
1	A	160	MET
1	A	166	ILE
1	A	173	ILE
1	A	183	ILE
1	A	184	LYS
1	A	213	LEU
1	A	331	GLU
1	A	360	ARG
1	B	30	LYS
1	B	41	LEU
1	B	42	LYS
1	B	58	LYS
1	B	114	LEU
1	B	125	GLU
1	B	141	ASP
1	B	142	CYS
1	B	148	MET
1	B	160	MET
1	B	164	THR
1	B	165	ASP
1	B	166	ILE
1	B	175	THR

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Mol	Chain	Res	Type
1	B	199	ILE
1	B	224	LYS
1	B	257	SER
1	B	275	ARG
1	B	362	VAL
1	B	379	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	84	HIS
1	B	122	HIS
1	B	279	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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 [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, 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	326/398 (81%)	-1.72	0 100 100	6, 15, 30, 40	0
1	B	324/398 (81%)	-1.73	0 100 100	6, 15, 30, 51	0
All	All	650/796 (81%)	-1.73	0 100 100	6, 15, 30, 51	0

There are no RSRZ outliers to report.

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 oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.