



# Full wwPDB X-ray Structure Validation Report ⓘ

Aug 25, 2025 – 02:17 PM JST

PDB ID : 8ZKJ / pdb\_00008zkj  
Title : The crystal structure of apo-LDHC  
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Deposited on : 2024-05-16  
Resolution : 2.38 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

<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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0rc1  
Xtriage (Phenix) : 2.0rc1  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.006 (Gargrove)  
Density-Fitness : 1.0.12  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.45.1

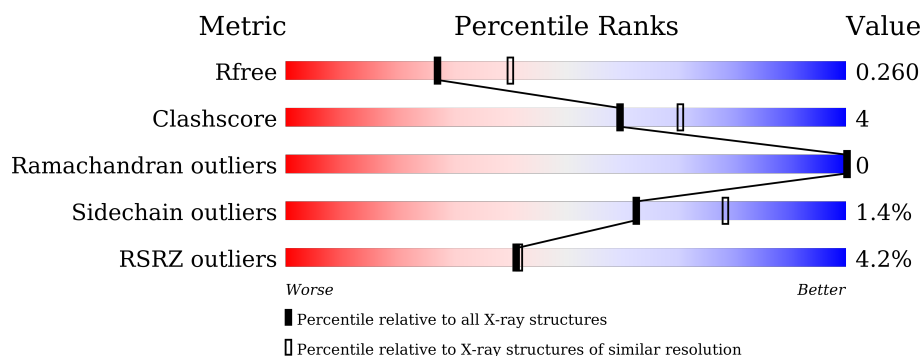
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.38 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))
$R_{free}$	164625	6699 (2.40-2.36)
Clashscore	180529	7414 (2.40-2.36)
Ramachandran outliers	177936	7337 (2.40-2.36)
Sidechain outliers	177891	7338 (2.40-2.36)
RSRZ outliers	164620	6699 (2.40-2.36)

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  $\geq 3$ , 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	341	
1	B	341	

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 5073 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 L-lactate dehydrogenase C chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	327	Total	C	N	O	S	0	0	0
			2508	1597	426	473	12			
1	B	332	Total	C	N	O	S	0	0	0
			2546	1623	432	479	12			

There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	initiating methionine	UNP P07864
A	2	ALA	-	expression tag	UNP P07864
A	56	GLU	LEU	conflict	UNP P07864
A	332	GLN	ILE	conflict	UNP P07864
A	334	LEU	-	expression tag	UNP P07864
A	335	GLU	-	expression tag	UNP P07864
A	336	HIS	-	expression tag	UNP P07864
A	337	HIS	-	expression tag	UNP P07864
A	338	HIS	-	expression tag	UNP P07864
A	339	HIS	-	expression tag	UNP P07864
A	340	HIS	-	expression tag	UNP P07864
A	341	HIS	-	expression tag	UNP P07864
B	1	MET	-	initiating methionine	UNP P07864
B	2	ALA	-	expression tag	UNP P07864
B	56	GLU	LEU	conflict	UNP P07864
B	332	GLN	ILE	conflict	UNP P07864
B	334	LEU	-	expression tag	UNP P07864
B	335	GLU	-	expression tag	UNP P07864
B	336	HIS	-	expression tag	UNP P07864
B	337	HIS	-	expression tag	UNP P07864
B	338	HIS	-	expression tag	UNP P07864
B	339	HIS	-	expression tag	UNP P07864
B	340	HIS	-	expression tag	UNP P07864
B	341	HIS	-	expression tag	UNP P07864

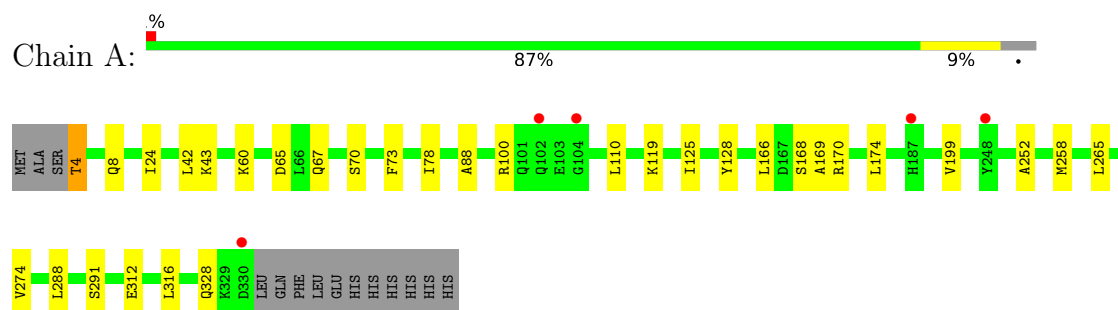
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	9	Total 9	O 9	0	0
2	B	10	Total 10	O 10	0	0

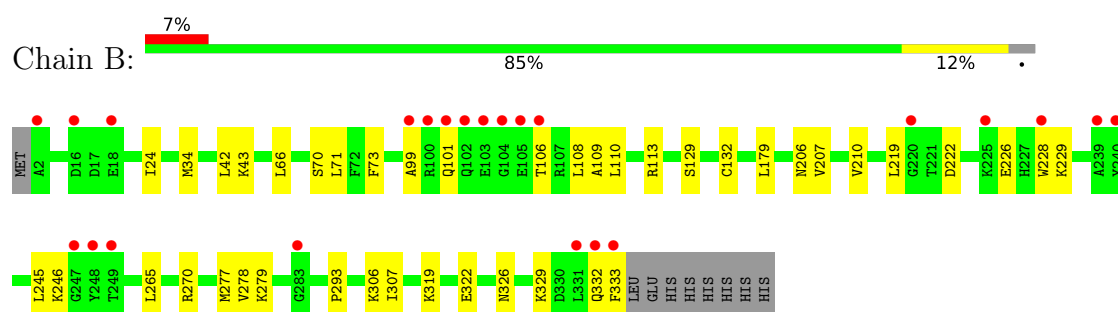
### 3 Residue-property plots [i](#)

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: L-lactate dehydrogenase C chain



- Molecule 1: L-lactate dehydrogenase C chain



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 41 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	86.00Å 86.00Å 194.77Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	58.05 – 2.38 58.05 – 2.38	Depositor EDS
% Data completeness (in resolution range)	100.0 (58.05-2.38) 100.0 (58.05-2.38)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.61 (at 2.37Å)	Xtriage
Refinement program	PHENIX (1.21_5207: ???)	Depositor
R, $R_{free}$	0.208 , 0.261 0.207 , 0.260	Depositor DCC
$R_{free}$ test set	2000 reflections (6.62%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	50.2	Xtriage
Anisotropy	0.054	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 28.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	5073	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	54.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.49% 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 [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	0.36	0/2548	0.52	0/3449
1	B	0.36	0/2587	0.51	0/3502
All	All	0.36	0/5135	0.52	0/6951

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 [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	2508	0	2594	22	0
1	B	2546	0	2629	28	0
2	A	9	0	0	1	0
2	B	10	0	0	1	0
All	All	5073	0	5223	43	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 4.

All (43) 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:4:THR:N	2:A:401:HOH:O	2.04	0.90

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:270:ARG:NH1	2:B:401:HOH:O	2.25	0.67
1:A:24:ILE:HD11	1:A:265:LEU:HD11	1.80	0.62
1:A:65:ASP:OD2	1:B:246:LYS:NZ	2.34	0.61
1:B:106:THR:HG22	1:B:108:LEU:N	2.16	0.61
1:A:169:ALA:HB1	1:B:71:LEU:HD23	1.85	0.57
1:B:222:ASP:OD1	1:B:229:LYS:HE2	2.05	0.56
1:A:4:THR:HA	1:B:226:GLU:OE2	2.06	0.55
1:B:24:ILE:HD11	1:B:265:LEU:HD11	1.89	0.53
1:A:274:VAL:O	1:A:291:SER:HA	2.09	0.53
1:A:42:LEU:HD22	1:B:43:LYS:HE2	1.93	0.51
1:A:4:THR:O	1:A:8:GLN:HG3	2.10	0.51
1:A:4:THR:HG22	1:B:226:GLU:OE2	2.11	0.51
1:A:312:GLU:O	1:A:316:LEU:HG	2.11	0.49
1:B:277:MET:HG2	1:B:279:LYS:H	1.76	0.49
1:B:101:GLN:HB2	1:B:110:LEU:HD22	1.94	0.49
1:A:199:VAL:HG13	1:A:316:LEU:HD12	1.96	0.47
1:A:43:LYS:HG3	1:A:258:MET:SD	2.54	0.47
1:B:106:THR:HG22	1:B:108:LEU:H	1.77	0.47
1:A:67:GLN:O	1:A:70:SER:OG	2.26	0.46
1:A:88:ALA:HA	1:A:128:TYR:HB3	1.98	0.46
1:A:170:ARG:NH2	1:A:174:LEU:HD21	2.31	0.45
1:B:277:MET:HG2	1:B:278:VAL:N	2.32	0.44
1:B:34:MET:HE1	1:B:66:LEU:HD11	2.00	0.44
1:B:129:SER:HB3	1:B:132:CYS:HB3	1.99	0.44
1:B:226:GLU:OE1	1:B:228:TRP:NE1	2.52	0.43
1:B:179:LEU:HD12	1:B:207:VAL:HG21	2.00	0.42
1:B:293:PRO:HG2	1:B:307:ILE:HD13	2.02	0.42
1:A:166:LEU:HD11	1:A:252:ALA:HB1	2.01	0.42
1:A:42:LEU:HD23	1:A:42:LEU:HA	1.65	0.42
1:B:70:SER:HA	1:B:73:PHE:CE2	2.55	0.42
1:B:326:ASN:HA	1:B:329:LYS:HE3	2.00	0.42
1:B:99:ALA:HB1	1:B:113:ARG:NH2	2.35	0.42
1:B:219:LEU:HD11	1:B:228:TRP:CG	2.55	0.41
1:B:332:GLN:HB2	1:B:333:PHE:CD2	2.55	0.41
1:A:60:LYS:HG2	1:B:245:LEU:HD13	2.02	0.41
1:B:206:ASN:HB2	1:B:210:VAL:C	2.45	0.41
1:A:100:ARG:HE	1:A:100:ARG:HA	1.86	0.41
1:B:319:LYS:NZ	1:B:322:GLU:OE1	2.47	0.41
1:A:70:SER:HA	1:A:73:PHE:CZ	2.55	0.41
1:A:42:LEU:HD12	1:B:42:LEU:HD12	2.03	0.40
1:B:106:THR:HB	1:B:109:ALA:HB3	2.02	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:125:ILE:HD13	1:A:125:ILE:HA	1.82	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	325/341 (95%)	320 (98%)	5 (2%)	0	100	100
1	B	330/341 (97%)	321 (97%)	9 (3%)	0	100	100
All	All	655/682 (96%)	641 (98%)	14 (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	282/295 (96%)	275 (98%)	7 (2%)	42	61
1	B	285/295 (97%)	284 (100%)	1 (0%)	89	95
All	All	567/590 (96%)	559 (99%)	8 (1%)	62	78

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	4	THR
1	A	78	ILE
1	A	110	LEU
1	A	119	LYS
1	A	168	SER
1	A	288	LEU
1	A	328	GLN
1	B	306	LYS

Sometimes 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	234	GLN
1	B	8	GLN
1	B	112	GLN
1	B	127	HIS
1	B	328	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 ⓘ

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	327/341 (95%)	0.09	5 (1%) 71 71	34, 50, 78, 118	0
1	B	332/341 (97%)	0.35	23 (6%) 24 24	39, 51, 84, 145	0
All	All	659/682 (96%)	0.22	28 (4%) 41 42	34, 50, 80, 145	0

All (28) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	333	PHE	5.3
1	B	101	GLN	4.9
1	B	2	ALA	3.5
1	B	240	TYR	3.4
1	A	330	ASP	3.1
1	B	102	GLN	3.1
1	A	104	GLY	3.1
1	B	249	THR	3.0
1	B	100	ARG	2.9
1	B	105	GLU	2.9
1	B	16	ASP	2.9
1	A	248	TYR	2.8
1	B	220	GLY	2.8
1	B	106	THR	2.8
1	B	247	GLY	2.8
1	B	103	GLU	2.7
1	B	332	GLN	2.7
1	B	248	TYR	2.6
1	A	102	GLN	2.5
1	B	104	GLY	2.5
1	B	228	TRP	2.4
1	B	331	LEU	2.4
1	B	239	ALA	2.3
1	B	99	ALA	2.2

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Mol	Chain	Res	Type	RSRZ
1	B	225	LYS	2.2
1	B	18	GLU	2.1
1	A	187	HIS	2.1
1	B	283	GLY	2.1

## 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.