



# Full wwPDB X-ray Structure Validation Report ⓘ

Jan 31, 2016 – 06:18 PM GMT

PDB ID : 1A5Z  
Title : LACTATE DEHYDROGENASE FROM THERMOTOGA MARITIMA (TMLDH)  
Authors : Auerbach, G.; Ostendorp, R.; Prade, L.; Korndorfer, I.; Dams, T.; Huber, R.; Jaenicke, R.  
Deposited on : 1998-02-18  
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](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) : **NOT EXECUTED**  
EDS : **NOT EXECUTED**  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

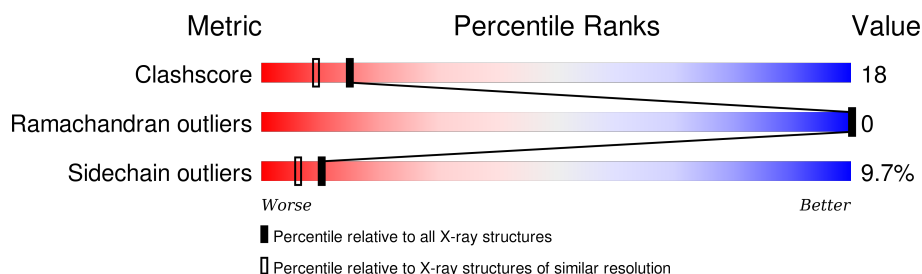
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.10 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))
Clashscore	102246	4460 (2.10-2.10)
Ramachandran outliers	100387	4413 (2.10-2.10)
Sidechain outliers	100360	4414 (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 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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	319	 69% 23% 5%

## 2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 2852 atoms, of which 12 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.

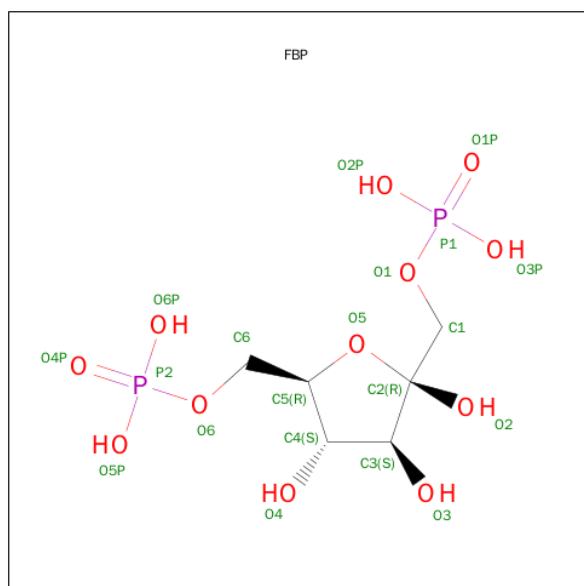
- Molecule 1 is a protein called L-LACTATE DEHYDROGENASE.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	S			
1	A	312	2415	1526	12	416	449	12	79	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	215	VAL	ILE	CONFLICT	UNP P16115

- Molecule 2 is SUGAR (FRUCTOSE-1,6-DIPHOSPHATE) (three-letter code: FBP) (formula: C<sub>6</sub>H<sub>14</sub>O<sub>12</sub>P<sub>2</sub>).

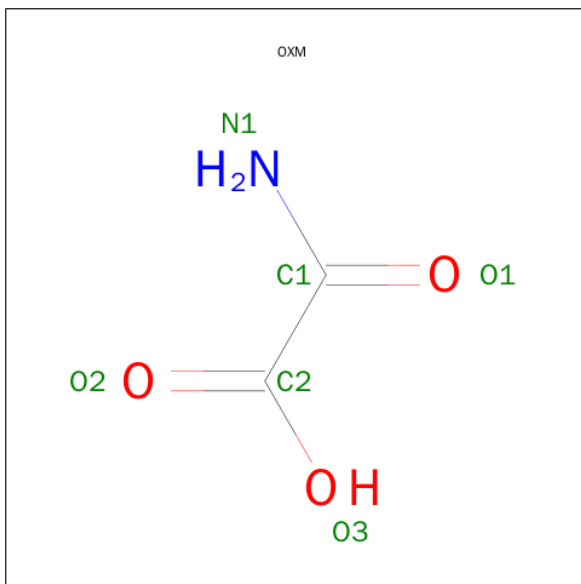


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	O	P	0	0
			20	6	12	2		
2	A	1	Total	C	O	P	0	0
			20	6	12	2		

- Molecule 3 is CADMIUM ION (three-letter code: CD) (formula: Cd).

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	3	Total	Cd		0	0
			3	3			

- Molecule 4 is OXAMIC ACID (three-letter code: OXM) (formula: C<sub>2</sub>H<sub>3</sub>NO<sub>3</sub>).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	C	N	O	0	0
			6	2	1	3		

- Molecule 5 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (three-letter code: NAD) (formula: C<sub>21</sub>H<sub>27</sub>N<sub>7</sub>O<sub>14</sub>P<sub>2</sub>).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	A	1	Total	C	N	O	P	0	0
			44	21	7	14	2		

- Molecule 6 is water.

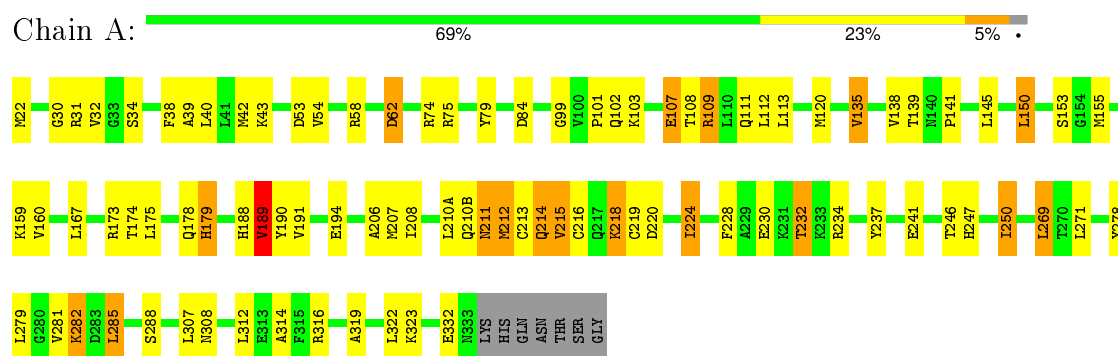
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	344	Total	O	0	0
			344	344		

### 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 ( $RSRZ > 2$ ). 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.

Note EDS was not executed.

#### • Molecule 1: L-LACTATE DEHYDROGENASE



## 4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section will therefore be incomplete.

Property	Value	Source
Space group	I 41 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	105.48Å 105.48Å 187.70Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	8.00 – 2.10	Depositor
% Data completeness (in resolution range)	97.7 (8.00-2.10)	Depositor
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	X-PLOR 3.8	Depositor
R, $R_{free}$	0.200 , 0.286	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2852	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	50.0	wwPDB-VP

## 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: OXM, FBP, NAD, CD

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	0.73	0/2440	0.89	3/3296 (0.1%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
1	A	215	VAL	N-CA-C	-6.52	93.40	111.00
1	A	189	VAL	CB-CA-C	-5.98	100.04	111.40
1	A	269	LEU	CA-CB-CG	5.66	128.31	115.30

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	2403	12	2461	81	1
2	A	40	0	20	7	1
3	A	3	0	0	0	0
4	A	6	0	2	0	0
5	A	44	0	26	8	0
6	A	344	0	0	15	0
All	All	2840	12	2509	84	1



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 18.

All (84) 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)
2:A:353:FBP:O3	2:A:353:FBP:H61	1.24	1.05
2:A:353:FBP:O3	2:A:353:FBP:C6	2.13	0.94
1:A:79:TYR:HB2	2:A:354:FBP:O2	1.74	0.87
1:A:30:GLY:HA3	5:A:352:NAD:O1A	1.78	0.82
1:A:246:THR:H	5:A:352:NAD:H72N	1.25	0.81
2:A:353:FBP:HO3	2:A:353:FBP:H61	1.49	0.78
1:A:103:LYS:O	1:A:107:GLU:HB2	1.86	0.75
1:A:174:THR:O	1:A:178:GLN:HG2	1.87	0.74
1:A:228:PHE:O	1:A:232:THR:HG23	1.86	0.74
1:A:218:LYS:HZ3	1:A:224:ILE:HD12	1.56	0.71
1:A:194:GLU:HG3	1:A:322:LEU:HD21	1.73	0.70
1:A:175:LEU:HD23	6:A:557:HOH:O	1.91	0.70
1:A:109:ARG:NH2	1:A:141:PRO:HG3	2.08	0.68
1:A:210(A):LEU:HD12	1:A:210(A):LEU:O	1.94	0.68
1:A:210(A):LEU:O	1:A:213:CYS:HB2	1.95	0.66
1:A:230:GLU:O	1:A:234:ARG:HG3	1.95	0.65
1:A:103:LYS:HB2	1:A:107:GLU:HG3	1.78	0.65
1:A:138:VAL:HG11	1:A:250:ILE:HD11	1.78	0.64
1:A:282:LYS:O	1:A:282:LYS:HE2	1.98	0.63
1:A:250:ILE:HG12	6:A:638:HOH:O	2.00	0.62
1:A:175:LEU:HA	6:A:557:HOH:O	1.98	0.62
1:A:32:VAL:HG13	1:A:250:ILE:HD12	1.82	0.61
1:A:150:LEU:HB2	6:A:667:HOH:O	1.99	0.61
1:A:237:TYR:O	1:A:241:GLU:HG3	2.01	0.61
1:A:135:VAL:HG13	1:A:160:VAL:HG22	1.84	0.60
1:A:188:HIS:ND1	2:A:353:FBP:O5P	2.31	0.59
1:A:173:ARG:HG2	1:A:189:VAL:HG23	1.84	0.59
1:A:108:THR:HB	1:A:111:GLN:HG3	1.84	0.59
1:A:211:ASN:O	1:A:215:VAL:HG23	2.02	0.59
1:A:74:ARG:HB2	6:A:656:HOH:O	2.02	0.59
1:A:74:ARG:HG2	1:A:75:ARG:N	2.17	0.58
1:A:53:ASP:OD2	5:A:352:NAD:H1B	2.03	0.58
1:A:99:GLY:O	5:A:352:NAD:H51A	2.05	0.56
1:A:38:PHE:CE2	1:A:42:MET:HE1	2.40	0.56
1:A:208:ILE:HB	1:A:212:MET:HG2	1.87	0.56
1:A:234:ARG:NH2	6:A:588:HOH:O	2.34	0.54
1:A:250:ILE:C	1:A:250:ILE:HD13	2.28	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:32:VAL:CG1	1:A:250:ILE:HD12	2.38	0.54
1:A:109:ARG:HH22	1:A:141:PRO:HG3	1.72	0.53
1:A:210(B):GLN:HB2	6:A:642:HOH:O	2.08	0.53
1:A:282:LYS:CE	1:A:282:LYS:H	2.23	0.52
1:A:79:TYR:HB2	2:A:354:FBP:HO2	1.74	0.51
1:A:79:TYR:CD1	2:A:354:FBP:H61	2.46	0.51
1:A:308:ASN:OD1	1:A:308:ASN:C	2.50	0.50
1:A:34:SER:HB3	1:A:62:ASP:OD2	2.12	0.50
1:A:74:ARG:HG2	1:A:75:ARG:O	2.12	0.49
1:A:214:GLN:OE1	1:A:219:CYS:O	2.32	0.48
1:A:108:THR:HB	1:A:111:GLN:CG	2.44	0.48
1:A:234:ARG:NH1	6:A:588:HOH:O	2.40	0.48
1:A:314:ALA:HA	6:A:457:HOH:O	2.14	0.47
1:A:282:LYS:CD	1:A:282:LYS:N	2.77	0.47
1:A:101:PRO:HD3	6:A:467:HOH:O	2.13	0.47
1:A:319:ALA:O	1:A:323:LYS:HG3	2.14	0.47
1:A:323:LYS:NZ	1:A:323:LYS:HB3	2.30	0.46
1:A:179:HIS:NE2	1:A:218:LYS:NZ	2.62	0.45
1:A:312:LEU:HG	1:A:316:ARG:NH1	2.32	0.45
1:A:30:GLY:CA	5:A:352:NAD:O1A	2.60	0.45
1:A:102:GLN:HA	1:A:112:LEU:HD13	1.99	0.45
1:A:246:THR:N	5:A:352:NAD:H72N	2.03	0.44
1:A:211:ASN:OD1	1:A:211:ASN:N	2.50	0.44
1:A:31:ARG:HH21	1:A:247:HIS:HE1	1.64	0.44
1:A:159:LYS:HB3	1:A:159:LYS:HE2	1.68	0.44
1:A:31:ARG:HH21	1:A:247:HIS:CE1	2.36	0.43
1:A:323:LYS:HZ2	1:A:323:LYS:HB3	1.83	0.43
1:A:84:ASP:HB2	6:A:593:HOH:O	2.18	0.43
1:A:224:ILE:HG22	6:A:681:HOH:O	2.17	0.43
1:A:108:THR:HG22	1:A:111:GLN:H	1.83	0.43
1:A:250:ILE:CG1	6:A:638:HOH:O	2.63	0.42
1:A:282:LYS:HD3	1:A:282:LYS:N	2.34	0.42
1:A:278:TYR:O	1:A:281:VAL:HG22	2.18	0.42
1:A:285:LEU:HD13	1:A:323:LYS:CG	2.48	0.42
1:A:271:LEU:O	1:A:288:SER:HA	2.19	0.42
1:A:22:MET:HA	6:A:492:HOH:O	2.20	0.42
1:A:139:THR:HG23	5:A:352:NAD:C4D	2.50	0.42
1:A:216:CYS:SG	1:A:219:CYS:HB2	2.59	0.42
1:A:39:ALA:O	1:A:43:LYS:HG2	2.20	0.41
1:A:188:HIS:CE1	1:A:190:TYR:CE2	3.09	0.41
1:A:323:LYS:NZ	6:A:544:HOH:O	2.52	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:120:MET:HG3	1:A:145:LEU:HB3	2.02	0.41
1:A:139:THR:HG23	5:A:352:NAD:H4D	2.03	0.40
1:A:153:SER:HB2	1:A:155:MET:CE	2.52	0.40
1:A:206:ALA:C	1:A:207:MET:HG3	2.42	0.40
1:A:282:LYS:NZ	1:A:323:LYS:HD2	2.36	0.40
1:A:279:LEU:HD21	1:A:307:LEU:HG	2.03	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:188:HIS:ND1	2:A:353:FBP:C3[10_765]	2.16	0.04

## 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	310/319 (97%)	291 (94%)	19 (6%)	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	259/265 (98%)	234 (90%)	25 (10%)	10 6

All (25) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	40	LEU
1	A	54	VAL
1	A	58	ARG
1	A	62	ASP
1	A	107	GLU
1	A	109	ARG
1	A	113	LEU
1	A	135	VAL
1	A	150	LEU
1	A	167	LEU
1	A	179	HIS
1	A	189	VAL
1	A	191	VAL
1	A	211	ASN
1	A	212	MET
1	A	214	GLN
1	A	218	LYS
1	A	220	ASP
1	A	224	ILE
1	A	232	THR
1	A	250	ILE
1	A	269	LEU
1	A	282	LYS
1	A	285	LEU
1	A	332	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	77	ASN
1	A	140	ASN
1	A	178	GLN
1	A	195	HIS
1	A	247	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 7 ligands modelled in this entry, 3 are monoatomic - leaving 4 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$
5	NAD	A	352	-	38,48,48	1.48	3 (7%)	47,73,73	1.72	8 (17%)
2	FBP	A	353	-	18,20,20	1.37	4 (22%)	21,32,32	1.53	5 (23%)
2	FBP	A	354	-	18,20,20	1.73	6 (33%)	21,32,32	1.50	6 (28%)
4	OXM	A	355	-	2,5,5	1.37	0	2,6,6	2.68	2 (100%)

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
5	NAD	A	352	-	-	0/22/62/62	0/5/5/5
2	FBP	A	353	-	-	0/13/32/32	0/1/1/1
2	FBP	A	354	-	-	0/13/32/32	0/1/1/1
4	OXM	A	355	-	-	0/0/4/4	0/0/0/0

All (13) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	354	FBP	P1-O2P	-2.51	1.45	1.54
2	A	354	FBP	P1-O1	-2.50	1.51	1.60
2	A	354	FBP	P2-O6	-2.38	1.52	1.60
2	A	353	FBP	P2-O6	-2.26	1.52	1.60
2	A	353	FBP	P1-O2P	-2.21	1.46	1.54
2	A	353	FBP	P1-O1	-2.16	1.53	1.60
2	A	353	FBP	P1-O3P	-2.03	1.47	1.54
5	A	352	NAD	C3N-C7N	2.11	1.53	1.50
2	A	354	FBP	C4-C5	2.48	1.59	1.53
2	A	354	FBP	O5-C2	2.48	1.47	1.43
2	A	354	FBP	O5-C5	2.96	1.50	1.43
5	A	352	NAD	O4B-C1B	3.58	1.45	1.41
5	A	352	NAD	O4D-C1D	5.53	1.48	1.41

All (21) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	352	NAD	N3A-C2A-N1A	-7.52	123.13	128.89
5	A	352	NAD	C2B-C1B-N9A	-3.12	109.52	114.29
5	A	352	NAD	C4B-O4B-C1B	-3.02	106.40	109.72
2	A	353	FBP	C6-C5-C4	-3.01	103.28	115.21
4	A	355	OXM	O1-C1-N1	-2.99	118.39	122.59
5	A	352	NAD	O4B-C4B-C5B	-2.55	100.21	109.32
2	A	354	FBP	O5P-P2-O6	-2.43	99.56	106.56
2	A	354	FBP	O3P-P1-O1P	-2.31	103.14	110.58
2	A	353	FBP	O5-C5-C4	-2.16	99.73	105.61
2	A	353	FBP	O3P-P1-O1	2.06	112.51	106.56
2	A	354	FBP	O5P-P2-O4P	2.12	117.40	110.58
2	A	354	FBP	O6-C6-C5	2.15	117.03	109.12
2	A	354	FBP	O6P-P2-O6	2.31	113.21	106.56
4	A	355	OXM	C2-C1-N1	2.33	119.89	115.90
5	A	352	NAD	O4B-C1B-N9A	2.41	113.15	108.10
2	A	353	FBP	O6-C6-C5	2.47	118.24	109.12
5	A	352	NAD	O5B-C5B-C4B	2.78	119.37	109.12
2	A	353	FBP	O3P-P1-O2P	2.82	118.12	107.38
2	A	354	FBP	O3P-P1-O2P	2.96	118.67	107.38
5	A	352	NAD	C4A-C5A-N7A	3.15	112.38	109.48
5	A	352	NAD	O4D-C1D-N1N	3.17	111.61	108.13

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 16 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	352	NAD	8	0
2	A	353	FBP	4	1
2	A	354	FBP	3	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 ⓘ

EDS was not executed - this section will therefore be empty.

### 6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

EDS was not executed - this section will therefore be empty.

### 6.3 Carbohydrates ⓘ

EDS was not executed - this section will therefore be empty.

### 6.4 Ligands ⓘ

EDS was not executed - this section will therefore be empty.

### 6.5 Other polymers ⓘ

EDS was not executed - this section will therefore be empty.