



# Full wwPDB X-ray Structure Validation Report

Feb 28, 2014 – 08:54 PM GMT

PDB ID : 2HVQ  
Title : Structure of Adenylated full-length T4 RNA Ligase 2  
Authors : Nandakumar, J.; Lima, C.D.  
Deposited on : 2006-07-30  
Resolution : 2.40 Å(reported)

This is a full wwPDB 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/ValidationPDFNotes.html>

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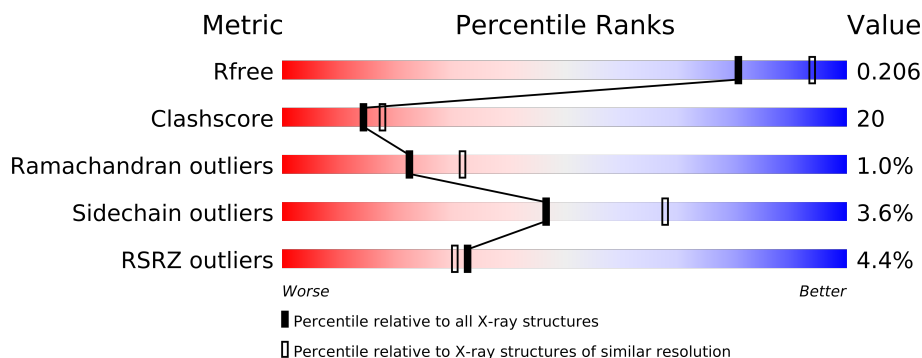
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.15 2013  
Xtriage (Phenix) : dev-1323  
EDS : stable22639  
Percentile statistics : 21963  
Refmac : 5.8.0049  
CCP4 : 6.3.0 (Settle)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)  
Validation Pipeline (wwPDB-VP) : stable22683

# 1 Overall quality at a glance


The reported resolution of this entry is 2.40 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))
$R_{free}$	66092	2207 (2.40-2.40)
Clashscore	79885	2789 (2.40-2.40)
Ramachandran outliers	78287	2736 (2.40-2.40)
Sidechain outliers	78261	2737 (2.40-2.40)
RSRZ outliers	66119	2210 (2.40-2.40)

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. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	335	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
2	MG	A	335	-	X

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2637 atoms, of which 0 are hydrogen and 0 are deuterium.

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 Hypothetical 37.6 kDa protein in Gp24-hoc intergenic region.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	P	S			
1	A	317	2519	1610	412	483	1	13	0	0	0

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	SER	-	CLONING ARTIFACT	UNP P32277
A	35	APK	LYS	MODIFIED RESIDUE	UNP P32277
A	112	GLY	CYS	SEE REMARK 999	UNP P32277

- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

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

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	116	Total	O	0	0
			116	116		



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	48.02Å 57.85Å 119.49Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	41.56 – 2.40 41.56 – 2.40	Depositor EDS
% Data completeness (in resolution range)	91.8 (41.56-2.40) 91.8 (41.56-2.40)	Depositor EDS
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.51 (at 2.39Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, $R_{free}$	0.211 , 0.274 0.215 , 0.206	Depositor DCC
$R_{free}$ test set	614 reflections (4.92%)	DCC
Wilson B-factor (Å <sup>2</sup> )	21.0	Xtriage
Anisotropy	0.421	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 30.4	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Outliers	0 of 12470 reflections	Xtriage
$F_o, F_c$ correlation	0.92	EDS
Total number of atoms	2637	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	29.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.38% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

## 5 Model quality ⓘ

### 5.1 Standard geometry ⓘ

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

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	0.35	0/2534	0.59	0/3418

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2519	0	2497	98	0
2	A	2	0	0	0	0
3	A	116	0	0	10	0
All	All	2637	0	2497	98	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 20.

All (98) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:70:ILE:HD12	1:A:300:GLU:HG2	1.57	0.84

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Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:97:PHE:CE1	1:A:122:ILE:HD13	2.18	0.79
1:A:133:VAL:HG13	1:A:137:MET:HB3	1.69	0.74
1:A:0:SER:HA	3:A:402:HOH:O	1.87	0.72
1:A:45:ILE:HD12	1:A:79:ILE:HG23	1.72	0.72
1:A:9:GLU:O	1:A:225:LYS:HG3	1.94	0.68
1:A:110:ASP:HB3	1:A:201:PHE:CE2	2.27	0.68
1:A:216:LEU:HD12	1:A:220:ASN:HB2	1.76	0.66
1:A:157:LYS:O	1:A:160:GLU:HG2	1.95	0.66
1:A:228:ASN:ND2	1:A:231:PHE:H	1.93	0.66
1:A:16:PHE:O	1:A:19:LYS:HB3	1.96	0.65
1:A:321:VAL:O	1:A:324:VAL:HG12	1.97	0.64
1:A:70:ILE:CD1	1:A:300:GLU:HG2	2.26	0.64
1:A:251:ASP:HB3	1:A:313:ILE:HD11	1.78	0.64
1:A:110:ASP:HB3	1:A:201:PHE:CD2	2.34	0.63
1:A:122:ILE:HD11	1:A:132:TYR:CE2	2.33	0.63
1:A:97:PHE:HE1	1:A:122:ILE:HD13	1.61	0.62
1:A:125:THR:OG1	1:A:129:ASP:HB3	2.00	0.62
1:A:0:SER:HB2	3:A:403:HOH:O	1.99	0.62
1:A:15:LYS:HB2	1:A:15:LYS:NZ	2.16	0.61
1:A:133:VAL:HG12	1:A:134:ASP:O	2.02	0.60
1:A:224:ILE:HD12	1:A:224:ILE:N	2.16	0.60
1:A:19:LYS:O	1:A:23:LEU:HD13	2.01	0.60
1:A:69:GLU:HB2	3:A:347:HOH:O	2.02	0.59
1:A:15:LYS:H	1:A:15:LYS:HZ2	1.49	0.59
1:A:193:ASN:HA	3:A:427:HOH:O	2.02	0.59
1:A:326:ARG:N	1:A:327:PRO:HD2	2.17	0.59
1:A:302:ILE:N	1:A:302:ILE:HD12	2.18	0.58
1:A:218:ASN:HD22	1:A:219:GLY:N	2.02	0.58
1:A:124:THR:HA	1:A:129:ASP:O	2.03	0.57
1:A:223:ALA:C	1:A:224:ILE:HD12	2.25	0.56
1:A:302:ILE:HD12	1:A:302:ILE:H	1.72	0.55
1:A:266:ARG:HA	1:A:269:ASN:HD22	1.71	0.55
1:A:133:VAL:CG1	1:A:137:MET:HB3	2.37	0.55
1:A:216:LEU:HB2	1:A:218:ASN:ND2	2.21	0.55
1:A:26:THR:HB	3:A:442:HOH:O	2.06	0.55
1:A:156:GLY:HA3	1:A:160:GLU:OE1	2.07	0.54
1:A:45:ILE:HD13	1:A:50:VAL:HG23	1.87	0.54
1:A:9:GLU:HG3	1:A:16:PHE:CZ	2.43	0.54
1:A:296:GLU:O	1:A:300:GLU:HG3	2.08	0.53
1:A:216:LEU:HB2	1:A:218:ASN:HD21	1.74	0.53
1:A:253:LYS:C	1:A:253:LYS:HD2	2.30	0.52
1:A:228:ASN:ND2	1:A:230:LYS:HB3	2.24	0.52

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Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:263:THR:O	1:A:267:VAL:HG23	2.09	0.52
1:A:52:CYS:SG	1:A:72:LEU:HD13	2.50	0.52
1:A:290:VAL:O	1:A:294:LEU:HD23	2.09	0.52
1:A:325:LEU:C	1:A:327:PRO:HD2	2.31	0.51
1:A:309:ASN:O	1:A:313:ILE:HG12	2.11	0.50
1:A:8:LEU:HB2	1:A:225:LYS:HG2	1.92	0.50
1:A:103:PRO:HD3	1:A:112:GLY:O	2.11	0.50
1:A:95:GLN:HG2	1:A:97:PHE:CE1	2.47	0.50
1:A:267:VAL:O	1:A:271:ILE:HG13	2.11	0.50
1:A:168:LEU:HD13	1:A:203:ALA:HB3	1.94	0.50
1:A:122:ILE:HD12	1:A:122:ILE:N	2.27	0.50
1:A:46:GLU:OE1	1:A:49:LYS:HE3	2.12	0.49
1:A:228:ASN:HD21	1:A:231:PHE:H	1.60	0.49
1:A:293:ILE:O	1:A:297:THR:HG22	2.12	0.49
1:A:319:LYS:O	1:A:322:GLN:HG2	2.13	0.49
1:A:228:ASN:HD22	1:A:230:LYS:HB3	1.77	0.49
1:A:15:LYS:O	1:A:19:LYS:N	2.45	0.49
1:A:133:VAL:HG13	1:A:137:MET:CB	2.42	0.48
1:A:250:ALA:O	1:A:253:LYS:HE3	2.13	0.48
1:A:312:LEU:O	1:A:316:GLU:HG2	2.13	0.48
1:A:316:GLU:O	1:A:320:MET:HG3	2.14	0.48
1:A:326:ARG:N	1:A:327:PRO:CD	2.77	0.48
1:A:15:LYS:HB2	1:A:15:LYS:HZ3	1.79	0.47
1:A:36:ILE:HB	1:A:99:GLU:HG2	1.96	0.47
1:A:17:ILE:HG22	1:A:21:TYR:CE1	2.50	0.47
1:A:304:LEU:C	1:A:306:GLN:H	2.18	0.46
1:A:266:ARG:HB2	1:A:266:ARG:HH11	1.80	0.46
1:A:1:MET:N	3:A:403:HOH:O	2.49	0.46
1:A:9:GLU:C	1:A:225:LYS:HG3	2.37	0.45
1:A:26:THR:CB	3:A:442:HOH:O	2.64	0.45
1:A:0:SER:HB2	3:A:409:HOH:O	2.15	0.45
1:A:317:LEU:O	1:A:321:VAL:HG23	2.17	0.44
1:A:247:LEU:HD11	1:A:316:GLU:HG3	1.99	0.44
1:A:257:ILE:O	1:A:260:CYS:HB2	2.17	0.44
1:A:168:LEU:HD12	1:A:168:LEU:H	1.81	0.44
1:A:122:ILE:HD11	1:A:132:TYR:CZ	2.53	0.44
1:A:40:ASN:HB3	3:A:340:HOH:O	2.17	0.43
1:A:97:PHE:CD1	1:A:122:ILE:HD13	2.54	0.43
1:A:175:TYR:O	1:A:179:VAL:HG23	2.18	0.43
1:A:291:GLN:O	1:A:295:GLU:HB2	2.17	0.43
1:A:218:ASN:ND2	1:A:220:ASN:H	2.17	0.43
1:A:297:THR:HG23	1:A:298:SER:N	2.34	0.43

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Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:15:LYS:O	1:A:19:LYS:HB2	2.19	0.42
1:A:13:ASN:C	1:A:13:ASN:HD22	2.22	0.42
1:A:313:ILE:O	1:A:316:GLU:HB2	2.19	0.42
1:A:23:LEU:HB3	1:A:25:LEU:HD13	2.00	0.42
1:A:9:GLU:HG3	1:A:16:PHE:CE2	2.55	0.42
1:A:8:LEU:CB	1:A:225:LYS:HG2	2.50	0.41
1:A:244:LYS:HB2	1:A:252:ASN:OD1	2.21	0.41
1:A:250:ALA:HA	1:A:253:LYS:HE3	2.02	0.41
1:A:244:LYS:HD3	1:A:316:GLU:OE2	2.21	0.41
1:A:326:ARG:C	1:A:328:ALA:H	2.23	0.41
1:A:253:LYS:HE3	1:A:253:LYS:HB3	1.90	0.41
1:A:13:ASN:HA	3:A:368:HOH:O	2.21	0.41
1:A:117:TYR:N	1:A:117:TYR:CD1	2.89	0.41

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	310/335 (92%)	286 (92%)	21 (7%)	3 (1%)	22	32

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	13	ASN
1	A	233	GLU
1	A	307	ALA

### 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	274/292 (94%)	264 (96%)	10 (4%)	47 68

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	13	ASN
1	A	15	LYS
1	A	64	ASP
1	A	168	LEU
1	A	208	LEU
1	A	218	ASN
1	A	225	LYS
1	A	253	LYS
1	A	254	LEU
1	A	280	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	13	ASN
1	A	74	ASN
1	A	181	HIS
1	A	218	ASN
1	A	220	ASN
1	A	228	ASN
1	A	269	ASN
1	A	291	GLN
1	A	306	GLN

### 5.3.3 RNA ⓘ

There are no RNA chains in this entry.

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

1 non-standard protein/DNA/RNA residue is modelled in this entry.

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	$\# Z  > 2$
1	APK	A	35	1,2	33,33,33	2.67	6 (18%)	47,47,47	1.97	9 (19%)

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
1	APK	A	35	1,2	-	0/19/37/37	0/1/3/3

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	35	APK	P-NZ	-12.93	1.47	1.61
1	A	35	APK	P-O5'	-4.89	1.53	1.57
1	A	35	APK	CA-C	2.99	1.53	1.50
1	A	35	APK	C4-N3	2.81	1.39	1.35
1	A	35	APK	O5'-C5'	2.47	1.55	1.44
1	A	35	APK	C2-N3	2.02	1.36	1.32

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	35	APK	O4'-C1'-N9	6.26	114.27	108.44
1	A	35	APK	O2P-P-NZ	5.55	119.38	106.25
1	A	35	APK	O2P-P-O1P	-5.53	97.13	109.89
1	A	35	APK	N3-C4-N9	3.64	132.01	125.43
1	A	35	APK	C-CA-N	-2.66	102.74	110.42
1	A	35	APK	O-C-CA	-2.63	119.24	125.12
1	A	35	APK	O1P-P-NZ	2.56	118.60	113.71
1	A	35	APK	O4'-C1'-C2'	2.53	110.66	106.77
1	A	35	APK	C8-N9-C1'	-2.14	122.17	126.38

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

## 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.

## 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 ⓘ

### 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	317/335 (94%)	-0.10	14 (4%) 33 30	7, 23, 67, 97	0

All (14) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	279	PRO	5.1
1	A	306	GLN	3.8
1	A	302	ILE	3.4
1	A	282	PHE	3.3
1	A	324	VAL	3.1
1	A	326	ARG	2.8
1	A	327	PRO	2.8
1	A	249	GLU	2.6
1	A	0	SER	2.5
1	A	251	ASP	2.4
1	A	307	ALA	2.3
1	A	321	VAL	2.2
1	A	325	LEU	2.1
1	A	253	LYS	2.0

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

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	RSR	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
1	APK	A	35	31/31	0.13	0.66	5,13,23,29	0

### 6.3 Carbohydrates

There are no carbohydrates in this entry.

### 6.4 Ligands

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	RSR	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
2	MG	A	335	1/1	0.27	8.49	23,23,23,23	0
2	MG	A	336	1/1	0.12	0.99	23,23,23,23	0

### 6.5 Other polymers

There are no such residues in this entry.