



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 07:09 PM GMT

PDB ID : 4NZV  
Title : DNA Double-Strand Break Repair Pathway Choice Is Directed by Distinct MRE11 Nuclease Activities  
Authors : Shibata, A.; Moiani, D.; Arvai, A.S.; Perry, J.; Harding, S.M.; Genois, M.; Maity, R.; Rossum-Fikkert, S.; Kertokallio, A.; Romoli, F.; Ismail, A.; Ismalaj, E.; Petricci, E.; Neale, M.J.; Bristow, R.G.; Masson, J.; Wyman, C.; Jeggo, P.A.; Tainer, J.A.  
Deposited on : 2013-12-12  
Resolution : 1.90 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

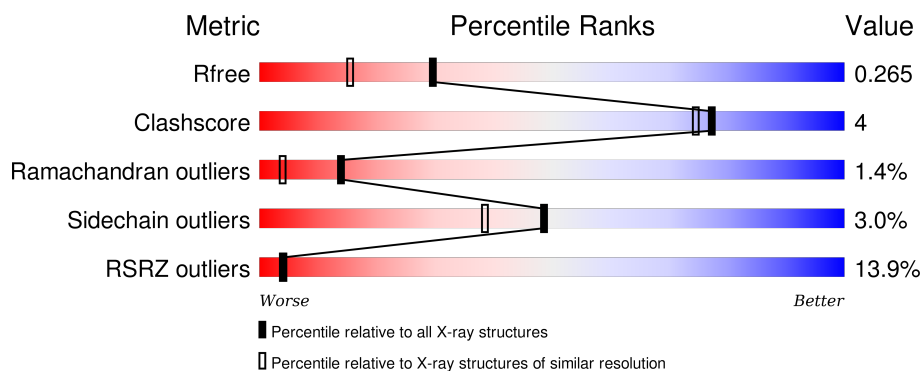
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.90 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	4755 (1.90-1.90)
Clashscore	102246	5398 (1.90-1.90)
Ramachandran outliers	100387	5338 (1.90-1.90)
Sidechain outliers	100360	5339 (1.90-1.90)
RSRZ outliers	91569	4766 (1.90-1.90)

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	336	<div> <div>12%</div> <div>89%</div> <div>7%</div> <div>..</div> </div>
1	B	336	<div> <div>15%</div> <div>82%</div> <div>13%</div> <div>..</div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5532 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 Exonuclease, putative.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	329	Total	C	N	O	S	0	1	0
			2639	1695	452	486	6			
1	B	324	Total	C	N	O	S	0	0	0
			2584	1663	439	476	6			

There are 26 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-11	MET	-	INITIATING METHIONINE	UNP Q9X1X0
A	-10	GLY	-	EXPRESSION TAG	UNP Q9X1X0
A	-9	SER	-	EXPRESSION TAG	UNP Q9X1X0
A	-8	ASP	-	EXPRESSION TAG	UNP Q9X1X0
A	-7	LYS	-	EXPRESSION TAG	UNP Q9X1X0
A	-6	ILE	-	EXPRESSION TAG	UNP Q9X1X0
A	-5	HIS	-	EXPRESSION TAG	UNP Q9X1X0
A	-4	HIS	-	EXPRESSION TAG	UNP Q9X1X0
A	-3	HIS	-	EXPRESSION TAG	UNP Q9X1X0
A	-2	HIS	-	EXPRESSION TAG	UNP Q9X1X0
A	-1	HIS	-	EXPRESSION TAG	UNP Q9X1X0
A	0	HIS	-	EXPRESSION TAG	UNP Q9X1X0
A	1	VAL	-	EXPRESSION TAG	UNP Q9X1X0
B	-11	MET	-	INITIATING METHIONINE	UNP Q9X1X0
B	-10	GLY	-	EXPRESSION TAG	UNP Q9X1X0
B	-9	SER	-	EXPRESSION TAG	UNP Q9X1X0
B	-8	ASP	-	EXPRESSION TAG	UNP Q9X1X0
B	-7	LYS	-	EXPRESSION TAG	UNP Q9X1X0
B	-6	ILE	-	EXPRESSION TAG	UNP Q9X1X0
B	-5	HIS	-	EXPRESSION TAG	UNP Q9X1X0
B	-4	HIS	-	EXPRESSION TAG	UNP Q9X1X0
B	-3	HIS	-	EXPRESSION TAG	UNP Q9X1X0
B	-2	HIS	-	EXPRESSION TAG	UNP Q9X1X0
B	-1	HIS	-	EXPRESSION TAG	UNP Q9X1X0
B	0	HIS	-	EXPRESSION TAG	UNP Q9X1X0

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Chain	Residue	Modelled	Actual	Comment	Reference
B	1	VAL	-	EXPRESSION TAG	UNP Q9X1X0

- Molecule 2 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	2	Total	Mn	0	0
			2	2		
2	A	2	Total	Mn	0	0
			2	2		

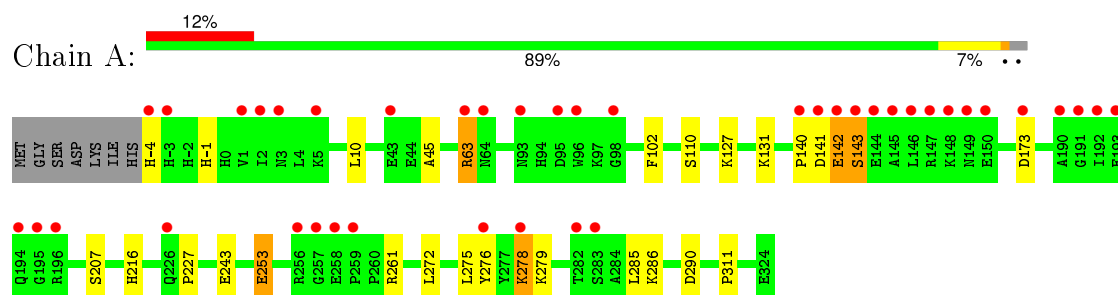
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	154	Total	O	0	0
			154	154		
3	B	151	Total	O	0	0
			151	151		

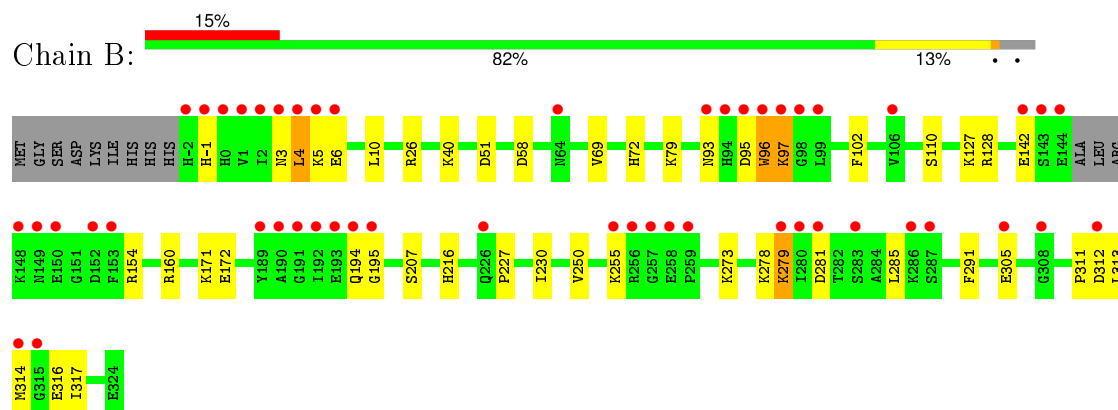
### 3 Residue-property plots [i](#)

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.

- Molecule 1: Exonuclease, putative



- Molecule 1: Exonuclease, putative



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	47.12Å 109.95Å 76.92Å 90.00° 100.21° 90.00°	Depositor
Resolution (Å)	44.48 – 1.90 44.48 – 1.90	Depositor EDS
% Data completeness (in resolution range)	89.9 (44.48-1.90) 90.0 (44.48-1.90)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.92 (at 1.89Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.2_1309)	Depositor
R, $R_{free}$	0.231 , 0.266 0.230 , 0.265	Depositor DCC
$R_{free}$ test set	1802 reflections (3.31%)	DCC
Wilson B-factor (Å <sup>2</sup> )	29.8	Xtriage
Anisotropy	0.355	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 57.0	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.58$ , $\langle L^2 \rangle = 0.43$	Xtriage
Outliers	1 of 60232 reflections (0.002%)	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	5532	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	52.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 57.28 % of the origin peak, indicating pseudo translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo translational symmetry is equal to 2.4210e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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: MN

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	0.27	0/2704	0.45	0/3660
1	B	0.27	0/2643	0.47	0/3576
All	All	0.27	0/5347	0.46	0/7236

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

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	2639	0	2621	13	0
1	B	2584	0	2562	26	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
3	A	154	0	0	1	0
3	B	151	0	0	7	0
All	All	5532	0	5183	38	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 (38) 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:B:95:ASP:O	1:B:97:LYS:N	2.21	0.73
1:B:3:ASN:O	1:B:5:LYS:N	2.20	0.73
1:B:-1:HIS:HB2	1:B:128:ARG:HA	1.76	0.66
1:B:72:HIS:ND1	3:B:572:HOH:O	2.28	0.66
1:B:279:LYS:HB3	1:B:305:GLU:HB2	1.77	0.66
1:B:285:LEU:HD21	1:B:311:PRO:HG3	1.79	0.64
1:B:154:ARG:NH1	3:B:559:HOH:O	2.32	0.63
1:B:160:ARG:NH1	3:B:564:HOH:O	2.30	0.63
1:A:285:LEU:HD21	1:A:311:PRO:HG3	1.83	0.61
1:B:26:ARG:NH2	1:B:314:MET:O	2.35	0.60
1:A:10:LEU:HD22	1:A:45:ALA:HB2	1.84	0.60
1:A:141:ASP:O	1:A:143:SER:N	2.35	0.59
1:B:110:SER:O	3:B:537:HOH:O	2.17	0.59
1:B:194:GLN:N	1:B:195:GLY:HA2	2.19	0.58
1:B:6:GLU:HG2	1:B:255:LYS:HG2	1.86	0.58
1:B:278:LYS:HD3	1:B:278:LYS:H	1.70	0.55
1:A:207:SER:HA	1:A:227:PRO:HD3	1.91	0.53
1:B:316:GLU:HG3	1:B:317:ILE:HG13	1.90	0.53
1:A:110:SER:O	3:A:518:HOH:O	2.19	0.50
1:A:253:GLU:HB3	1:A:261:ARG:HG3	1.94	0.49
1:A:63:ARG:NE	1:A:63:ARG:H	2.11	0.48
1:A:102:PHE:HD2	1:B:102:PHE:HD1	1.62	0.47
1:B:273:LYS:HG2	1:B:291:PHE:CZ	2.50	0.47
1:B:207:SER:HA	1:B:227:PRO:HD3	1.95	0.47
1:A:131:LYS:O	1:A:173:ASP:HB2	2.15	0.47
1:A:278:LYS:HE2	1:A:279:LYS:H	1.80	0.47
1:B:58:ASP:OD2	3:B:507:HOH:O	2.21	0.44
1:B:230:ILE:HG21	1:B:250:VAL:HG21	2.00	0.44
1:A:243:GLU:HG3	1:A:272:LEU:HB2	1.98	0.44
1:B:127:LYS:NZ	3:B:615:HOH:O	2.50	0.43
1:A:286:LYS:NZ	1:A:290:ASP:OD2	2.52	0.42
1:B:51:ASP:HA	1:B:127:LYS:HB3	2.02	0.42
1:B:311:PRO:O	1:B:313:LEU:N	2.53	0.42
1:A:-1:HIS:HE1	1:A:127:LYS:HE2	1.85	0.42
1:B:69:VAL:HG23	3:B:613:HOH:O	2.19	0.42
1:B:281:ASP:N	1:B:281:ASP:OD2	2.52	0.41
1:B:278:LYS:HG2	1:B:279:LYS:H	1.85	0.41
1:B:278:LYS:CD	1:B:278:LYS:H	2.32	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	328/336 (98%)	320 (98%)	5 (2%)	3 (1%)	21	9
1	B	320/336 (95%)	303 (95%)	11 (3%)	6 (2%)	10	2
All	All	648/672 (96%)	623 (96%)	16 (2%)	9 (1%)	14	4

All (9) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	4	LEU
1	B	96	TRP
1	A	142	GLU
1	A	216	HIS
1	B	171	LYS
1	B	216	HIS
1	B	142	GLU
1	B	312	ASP
1	A	140	PRO

### 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	285/298 (96%)	277 (97%)	8 (3%)	51	41
1	B	277/298 (93%)	268 (97%)	9 (3%)	46	35
All	All	562/596 (94%)	545 (97%)	17 (3%)	48	38

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	-4	HIS
1	A	63	ARG
1	A	142	GLU
1	A	143	SER
1	A	253	GLU
1	A	275	LEU
1	A	276	TYR
1	A	278	LYS
1	B	4	LEU
1	B	10	LEU
1	B	40	LYS
1	B	79	LYS
1	B	93	ASN
1	B	96	TRP
1	B	97	LYS
1	B	172	GLU
1	B	279	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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 carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 4 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 ⓘ

### 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	329/336 (97%)	0.68	41 (12%)	5   5	26, 42, 102, 142	0
1	B	324/336 (96%)	0.98	50 (15%)	3   3	27, 47, 109, 148	0
All	All	653/672 (97%)	0.83	91 (13%)	4   4	26, 44, 108, 148	0

All (91) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	2	ILE	18.1
1	B	192	ILE	14.6
1	B	195	GLY	11.9
1	A	145	ALA	11.4
1	A	146	LEU	11.3
1	B	193	GLU	8.8
1	A	195	GLY	8.4
1	B	1	VAL	8.3
1	A	194	GLN	8.2
1	B	194	GLN	7.2
1	A	276	TYR	6.7
1	B	4	LEU	6.0
1	A	193	GLU	5.7
1	A	148	LYS	5.7
1	A	144	GLU	5.7
1	B	143	SER	5.6
1	A	147	ARG	5.6
1	A	192	ILE	5.5
1	B	191	GLY	5.3
1	B	3	ASN	5.3
1	B	0	HIS	5.2
1	B	96	TRP	5.0
1	B	-1	HIS	4.5
1	A	142	GLU	4.5

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Mol	Chain	Res	Type	RSRZ
1	B	148	LYS	4.5
1	A	3	ASN	4.4
1	B	5	LYS	4.3
1	B	280	ILE	4.2
1	A	143	SER	4.1
1	B	144	GLU	4.1
1	B	315	GLY	4.0
1	B	98	GLY	3.8
1	B	149	ASN	3.8
1	A	141	ASP	3.8
1	A	-3	HIS	3.8
1	B	308	GLY	3.7
1	A	96	TRP	3.7
1	B	97	LYS	3.7
1	A	256	ARG	3.7
1	B	190	ALA	3.7
1	B	257	GLY	3.6
1	A	-4	HIS	3.5
1	A	149	ASN	3.5
1	B	226	GLN	3.4
1	A	95	ASP	3.4
1	A	196	ARG	3.3
1	A	150	GLU	3.3
1	A	190	ALA	3.2
1	B	94	HIS	3.2
1	A	2	ILE	2.9
1	A	5	LYS	2.9
1	B	153	PHE	2.9
1	A	63	ARG	2.9
1	B	142	GLU	2.8
1	B	279	LYS	2.8
1	B	305	GLU	2.8
1	A	98	GLY	2.8
1	A	93	ASN	2.7
1	A	259	PRO	2.6
1	A	258	GLU	2.6
1	B	281	ASP	2.6
1	B	256	ARG	2.5
1	B	259	PRO	2.5
1	B	64	ASN	2.5
1	B	283	SER	2.5
1	A	282	THR	2.5

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Mol	Chain	Res	Type	RSRZ
1	B	258	GLU	2.5
1	B	-2	HIS	2.4
1	A	257	GLY	2.4
1	B	286	LYS	2.4
1	A	191	GLY	2.3
1	B	6	GLU	2.3
1	A	140	PRO	2.3
1	B	93	ASN	2.3
1	A	226	GLN	2.3
1	A	1	VAL	2.3
1	A	64	ASN	2.2
1	B	152	ASP	2.2
1	B	255	LYS	2.2
1	B	150	GLU	2.2
1	B	95	ASP	2.2
1	B	106	VAL	2.2
1	A	278	LYS	2.1
1	A	283	SER	2.1
1	B	287	SER	2.1
1	A	43	GLU	2.1
1	A	173	ASP	2.1
1	B	312	ASP	2.0
1	B	99	LEU	2.0
1	B	189	TYR	2.0
1	B	314	MET	2.0

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

There are no non-standard protein/DNA/RNA residues in this entry.

## 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	RSCC	RSR	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
2	MN	B	401	1/1	0.99	0.14	-0.09	28,28,28,28	1
2	MN	A	401	1/1	0.98	0.06	-1.24	33,33,33,33	1
2	MN	A	402	1/1	0.96	0.10	-	39,39,39,39	1
2	MN	B	402	1/1	0.95	0.20	-	43,43,43,43	1

## 6.5 Other polymers [i](#)

There are no such residues in this entry.