



# wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 18, 2023 – 07:23 PM EDT

PDB ID : 2EJ6  
Title : Crystal analysis of delta1-pyrroline-5-carboxylate dehydrogenase from *Thermus thermophilus* with bound D-proline  
Authors : Inagaki, E.; Sakamoto, K.; Yokoyama, S.; RIKEN Structural Genomics/Proteomics Initiative (RSGI)  
Deposited on : 2007-03-15  
Resolution : 2.06 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 : 4.02b-467  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.36  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.36

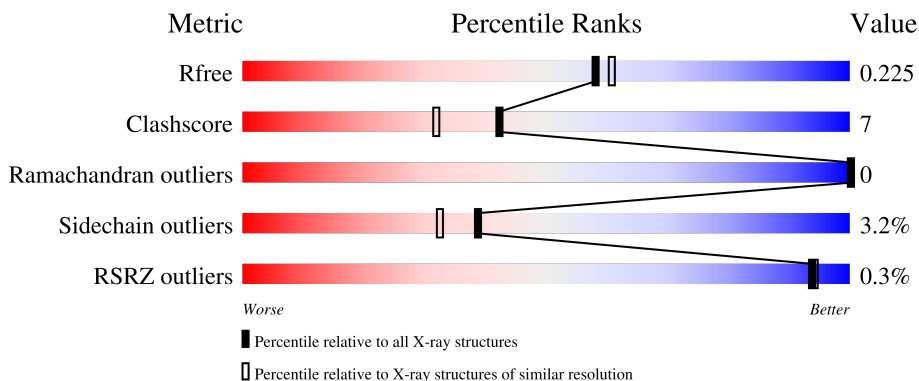
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*



The reported resolution of this entry is 2.06 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))
$R_{free}$	130704	2684 (2.08-2.04)
Clashscore	141614	2801 (2.08-2.04)
Ramachandran outliers	138981	2768 (2.08-2.04)
Sidechain outliers	138945	2768 (2.08-2.04)
RSRZ outliers	127900	2646 (2.08-2.04)

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	516	 84% 15%
1	B	516	 85% 15%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	ACT	A	1520	-	-	X	-
2	ACT	A	5520	-	-	X	-
5	MPD	A	1531	X	-	-	-
5	MPD	A	1532	X	-	-	-
5	MPD	B	1534	X	-	-	-
5	MPD	B	5532	X	-	-	-
5	MPD	B	5535	X	-	-	-
5	MPD	B	5537	X	-	-	-

## 2 Entry composition [i](#)

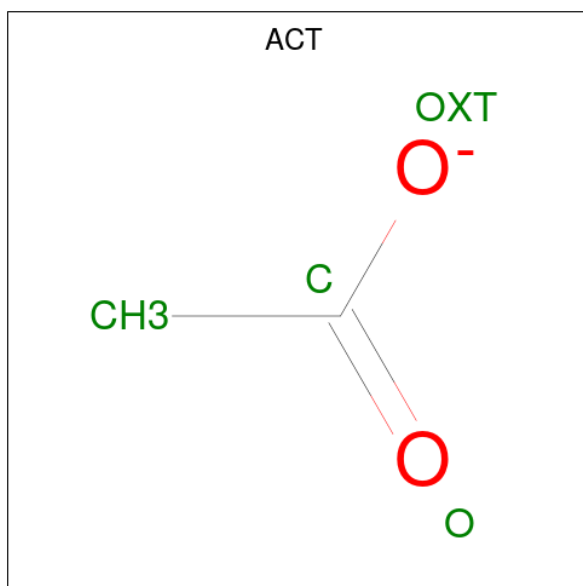
There are 6 unique types of molecules in this entry. The entry contains 8802 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 1-pyrroline-5-carboxylate dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	516	Total 4068	C 2618	N 695	O 745	S 10	0	8	0
1	B	516	Total 4066	C 2615	N 698	O 743	S 10	0	8	0

- Molecule 2 is ACETATE ION (three-letter code: ACT) (formula: C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>).

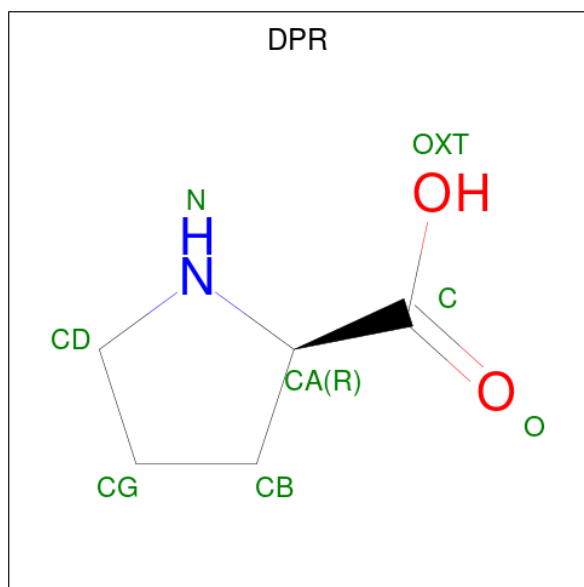


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
2	A	1	Total 4	C 2	O 2	0	0
2	A	1	Total 4	C 2	O 2	0	0

- Molecule 3 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total Na 1 1	0	0
3	B	1	Total Na 1 1	0	0

- Molecule 4 is D-PROLINE (three-letter code: DPR) (formula:  $C_5H_9NO_2$ ).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total C N O 8 5 1 2	0	0
4	B	1	Total C N O 8 5 1 2	0	0

- Molecule 5 is (4S)-2-METHYL-2,4-PENTANEDIOL (three-letter code: MPD) (formula:  $C_6H_{14}O_2$ ).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total C O 8 6 2	0	0
5	A	1	Total C O 8 6 2	0	0
5	A	1	Total C O 8 6 2	0	0
5	A	1	Total C O 8 6 2	0	0
5	A	1	Total C O 8 6 2	0	0
5	B	1	Total C O 8 6 2	0	0
5	B	1	Total C O 8 6 2	0	0
5	B	1	Total C O 8 6 2	0	0
5	B	1	Total C O 8 6 2	0	0
5	B	1	Total C O 8 6 2	0	0
5	B	1	Total C O 8 6 2	0	0
5	B	1	Total C O 8 6 2	0	0


- Molecule 6 is water.

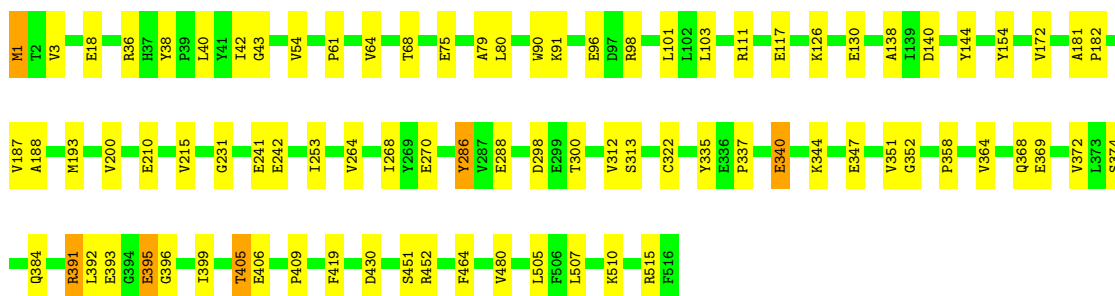
<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>		<b>ZeroOcc</b>	<b>AltConf</b>
6	A	275	Total 275	O 275	0	8
6	B	271	Total 271	O 271	0	3

### 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: 1-pyrroline-5-carboxylate dehydrogenase

Chain A:  84% 15%



- Molecule 1: 1-pyrroline-5-carboxylate dehydrogenase

Chain B:  85% 15%





## 4 Data and refinement statistics

Property	Value	Source
Space group	H 3	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	100.76Å 100.76Å 279.93Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	24.68 – 2.06 24.68 – 2.06	Depositor EDS
% Data completeness (in resolution range)	95.8 (24.68-2.06) 95.9 (24.68-2.06)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	0.09	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.32 (at 2.06Å)	Xtrriage
Refinement program	REFMAC 5.2.0005	Depositor
R, $R_{free}$	0.170 , 0.231 0.169 , 0.225	Depositor DCC
$R_{free}$ test set	3333 reflections (5.07%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	21.2	Xtrriage
Anisotropy	0.848	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 53.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.45$ , $\langle L^2 \rangle = 0.27$	Xtrriage
Estimated twinning fraction	0.077 for -h-k,k,-l	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	8802	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	23.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.05% 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](#)

Bond lengths and bond angles in the following residue types are not validated in this section: NA, MPD, DPR, ACT

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	1.04	3/4204 (0.1%)	0.90	2/5701 (0.0%)
1	B	1.02	1/4206 (0.0%)	0.91	5/5702 (0.1%)
All	All	1.03	4/8410 (0.0%)	0.90	7/11403 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	288	GLU	CB-CG	5.45	1.62	1.52
1	B	210	GLU	CG-CD	5.16	1.59	1.51
1	A	18	GLU	CB-CG	5.09	1.61	1.52
1	A	18	GLU	CG-CD	5.08	1.59	1.51

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	111	ARG	NE-CZ-NH2	-7.15	116.72	120.30
1	A	111	ARG	NE-CZ-NH2	-6.81	116.89	120.30
1	A	430	ASP	CB-CG-OD1	6.20	123.88	118.30
1	B	473	ARG	NE-CZ-NH2	6.08	123.34	120.30
1	B	48	ASP	CB-CG-OD2	-5.81	113.07	118.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	154	TYR	Peptide

## 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	4068	0	4054	57	0
1	B	4066	0	4049	54	0
2	A	8	0	6	7	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	8	0	8	0	0
4	B	8	0	8	0	0
5	A	40	0	70	5	0
5	B	56	0	98	13	0
6	A	275	0	0	5	0
6	B	271	0	0	7	0
All	All	8802	0	8293	115	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 7.

The worst 5 of 115 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:36:ARG:HH21	5:B:5537:MPD:HM2	0.94	1.10
1:A:286[B]:TYR:HD2	6:A:5643:HOH:O	1.43	1.01
1:B:36:ARG:NH2	5:B:5537:MPD:HM2	1.79	0.96
1:B:286[B]:TYR:CE1	1:B:506[B]:PHE:CE2	2.65	0.84
2:A:1520:ACT:H2	1:B:172:VAL:HG11	1.59	0.83

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	521/516 (101%)	507 (97%)	14 (3%)	0	100	100
1	B	521/516 (101%)	506 (97%)	15 (3%)	0	100	100
All	All	1042/1032 (101%)	1013 (97%)	29 (3%)	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	415/407 (102%)	395 (95%)	20 (5%)	25	18
1	B	415/407 (102%)	405 (98%)	10 (2%)	49	43
All	All	830/814 (102%)	800 (96%)	30 (4%)	39	28

5 of 30 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	393	GLU
1	B	419	PHE
1	A	409	PRO
1	B	464	PHE
1	B	322[A]	CYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	384	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 monosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

Of 18 ligands modelled in this entry, 2 are monoatomic - leaving 16 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	$\# Z  > 2$
2	ACT	A	5520	-	3,3,3	0.79	0	3,3,3	1.09	0
4	DPR	B	5517	-	8,8,8	1.15	0	10,10,10	1.42	2 (20%)
5	MPD	A	1536	-	7,7,7	0.34	0	9,10,10	0.59	0
5	MPD	B	5530	-	7,7,7	0.47	0	9,10,10	1.27	0
5	MPD	B	5532	-	7,7,7	0.26	0	9,10,10	0.28	0
5	MPD	B	5534	-	7,7,7	0.60	0	9,10,10	0.82	0
5	MPD	A	5531	-	7,7,7	0.32	0	9,10,10	0.39	0
4	DPR	A	1517	-	8,8,8	0.73	0	10,10,10	1.51	2 (20%)
5	MPD	B	5535	-	7,7,7	0.43	0	9,10,10	0.36	0
2	ACT	A	1520	-	3,3,3	0.60	0	3,3,3	2.09	2 (66%)
5	MPD	A	1530	-	7,7,7	0.45	0	9,10,10	0.95	0
5	MPD	A	1531	-	7,7,7	0.41	0	9,10,10	0.64	0
5	MPD	B	5536	-	7,7,7	0.44	0	9,10,10	0.97	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
5	MPD	B	5537	-	7,7,7	0.52	0	9,10,10	0.79	0
5	MPD	A	1532	-	7,7,7	0.52	0	9,10,10	0.78	0
5	MPD	B	1534	-	7,7,7	0.46	0	9,10,10	1.09	0

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
4	DPR	B	5517	-	-	0/4/11/11	0/1/1/1
5	MPD	A	1536	-	-	0/5/5/5	-
5	MPD	B	5530	-	-	1/5/5/5	-
5	MPD	B	5532	-	1/1/2/2	0/5/5/5	-
5	MPD	B	5534	-	-	5/5/5/5	-
5	MPD	A	5531	-	-	1/5/5/5	-
4	DPR	A	1517	-	-	0/4/11/11	0/1/1/1
5	MPD	B	5535	-	1/1/2/2	0/5/5/5	-
5	MPD	A	1530	-	-	2/5/5/5	-
5	MPD	A	1531	-	1/1/2/2	2/5/5/5	-
5	MPD	B	5536	-	-	3/5/5/5	-
5	MPD	B	5537	-	1/1/2/2	1/5/5/5	-
5	MPD	A	1532	-	1/1/2/2	1/5/5/5	-
5	MPD	B	1534	-	1/1/2/2	1/5/5/5	-

There are no bond length outliers.

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	1517	DPR	OXT-C-CA	2.81	122.75	113.40
4	B	5517	DPR	OXT-C-CA	2.59	122.01	113.40
2	A	1520	ACT	OXT-C-CH3	2.58	125.84	115.18
2	A	1520	ACT	OXT-C-O	-2.52	112.77	122.05
4	A	1517	DPR	OXT-C-O	-2.35	118.75	124.09

5 of 6 chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
5	A	1531	MPD	C4
5	A	1532	MPD	C4
5	B	1534	MPD	C4

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Mol	Chain	Res	Type	Atom
5	B	5532	MPD	C4
5	B	5535	MPD	C4

5 of 17 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	1530	MPD	C2-C3-C4-O4
5	A	1530	MPD	C2-C3-C4-C5
5	B	5534	MPD	C1-C2-C3-C4
5	B	5534	MPD	C2-C3-C4-O4
5	B	5536	MPD	C2-C3-C4-O4

There are no ring outliers.

10 monomers are involved in 25 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	5520	ACT	5	0
5	A	1536	MPD	1	0
5	B	5532	MPD	3	0
5	B	5534	MPD	5	0
2	A	1520	ACT	2	0
5	A	1530	MPD	2	0
5	A	1531	MPD	1	0
5	B	5536	MPD	2	0
5	B	5537	MPD	3	0
5	A	1532	MPD	1	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 [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, 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	516/516 (100%)	-0.47	0 100   100	13, 21, 34, 43	0
1	B	516/516 (100%)	-0.46	3 (0%) 89   90	13, 21, 34, 41	0
All	All	1032/1032 (100%)	-0.46	3 (0%) 94   94	13, 21, 34, 43	0

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	422	VAL	2.2
1	B	423	LEU	2.2
1	B	1[A]	MET	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 monosaccharides in this entry.

### 6.4 Ligands [i](#)

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. 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	B-factors(Å <sup>2</sup> )	Q<0.9
5	MPD	B	5536	8/8	0.82	0.26	44,50,53,53	0
5	MPD	B	5537	8/8	0.86	0.26	52,55,55,56	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
5	MPD	A	1536	8/8	0.87	0.22	67,68,69,69	0
5	MPD	B	1534	8/8	0.87	0.25	42,45,46,49	0
5	MPD	A	1532	8/8	0.91	0.13	44,47,48,50	0
5	MPD	B	5534	8/8	0.91	0.13	40,42,45,47	0
5	MPD	A	5531	8/8	0.92	0.13	52,53,56,57	0
5	MPD	B	5535	8/8	0.93	0.20	33,36,38,38	0
5	MPD	B	5532	8/8	0.93	0.19	50,54,55,57	0
4	DPR	B	5517	8/8	0.93	0.15	33,35,36,37	0
4	DPR	A	1517	8/8	0.94	0.11	32,35,36,36	0
3	NA	A	1540	1/1	0.94	0.08	31,31,31,31	0
5	MPD	A	1531	8/8	0.94	0.12	41,44,48,51	0
3	NA	B	5540	1/1	0.94	0.12	37,37,37,37	0
5	MPD	B	5530	8/8	0.96	0.11	27,33,34,34	0
5	MPD	A	1530	8/8	0.96	0.09	30,33,36,39	0
2	ACT	A	5520	4/4	0.96	0.14	39,40,40,41	0
2	ACT	A	1520	4/4	0.97	0.08	26,26,27,29	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.