Full wwPDB X-ray Structure Validation Report (i)

Sep 17, 2023 – 09:16 PM EDT

PDB ID	:	4XR2
Title	:	Escherichia Coli Replication Terminator Protein (Tus) H114A mutant Complexed With DNA- TerA lock.
Authors	:	Oakley, A.J.
Deposited on	:	2015-01-20
Resolution	:	2.35 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*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

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

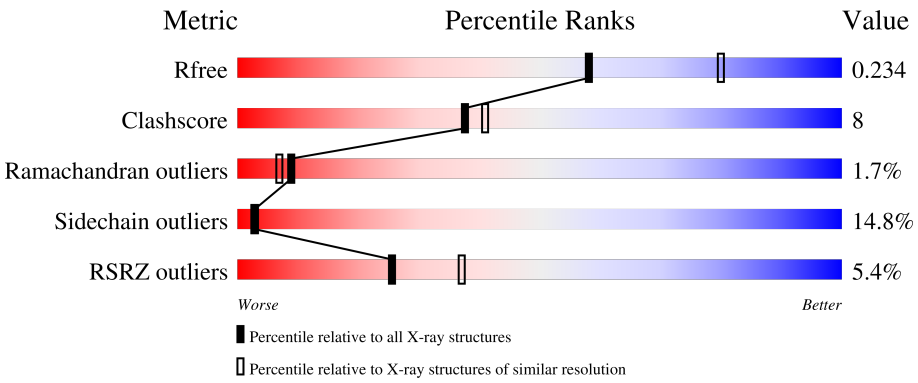
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35.1

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.35 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	1164 (2.36-2.36)
Clashscore	141614	1232 (2.36-2.36)
Ramachandran outliers	138981	1211 (2.36-2.36)
Sidechain outliers	138945	1212 (2.36-2.36)
RSRZ outliers	127900	1150 (2.36-2.36)

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 >=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 <=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	316	5% 73% 19% . . .
2	B	16	6% 56% 25% 6% 12%
3	C	16	12% 81% 19%

2 Entry composition (i)

There are 7 unique types of molecules in this entry. The entry contains 3184 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 DNA replication terminus site-binding protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	305	2509	1596	466	444	3	0	5	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-6	MET	-	initiating methionine	UNP P16525
A	-5	HIS	-	expression tag	UNP P16525
A	-4	HIS	-	expression tag	UNP P16525
A	-3	HIS	-	expression tag	UNP P16525
A	-2	HIS	-	expression tag	UNP P16525
A	-1	HIS	-	expression tag	UNP P16525
A	0	HIS	-	expression tag	UNP P16525
A	144	ALA	HIS	engineered mutation	UNP P16525

- Molecule 2 is a DNA chain called DNA (5'-D(*TP*AP*GP*TP*TP*AP*CP*AP*AP*CP*AP*TP*AP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	B	14	282	137	52	80	13	0	0	0

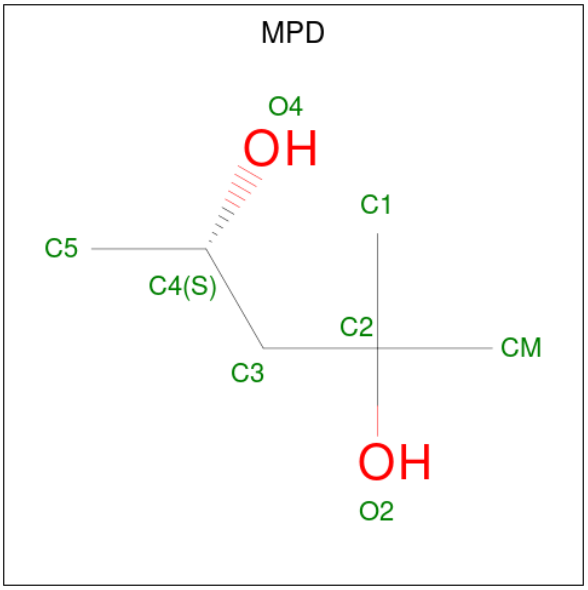
- Molecule 3 is a DNA chain called DNA (5'-D(*TP*GP*AP*TP*AP*TP*GP*TP*TP*GP*TP*AP*AP*CP*TP*A)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
3	C	16	310	149	52	94	15	0	0	0

- Molecule 4 is IODIDE ION (three-letter code: IOD) (formula: I).

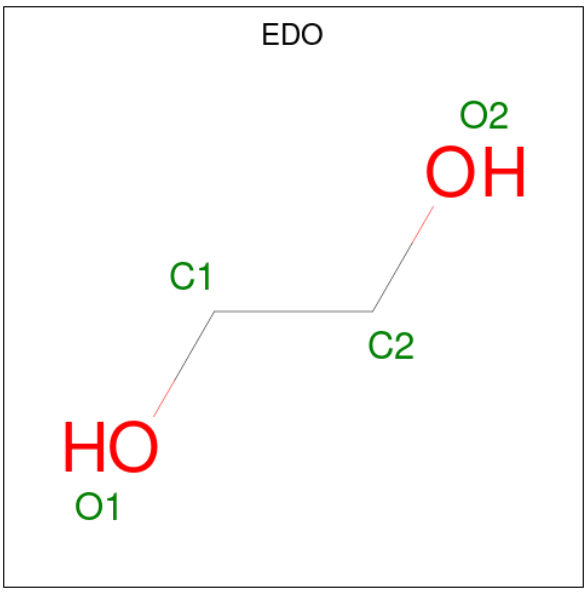
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	I		
4	A	2	2	2	0	0

- 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
			Total	C	O		
5	A	1	8	6	2	0	0

- Molecule 6 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).



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

- Molecule 7 is water.

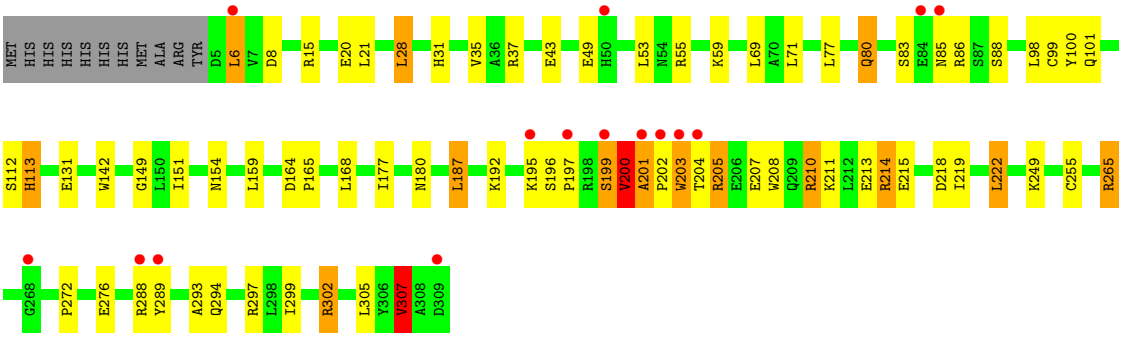
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
7	A	50	50	50	0	0
			Total	O		
7	B	10	10	10	0	0
			Total	O		
7	C	9	9	9	0	0

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.

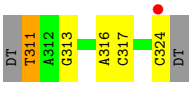
• Molecule 1: DNA replication terminus site-binding protein

Chain A:



• Molecule 2: DNA (5'-D(*TP*AP*GP*TP*TP*AP*CP*AP*AP*CP*AP*TP*AP*C)-3')

Chain B:



• Molecule 3: DNA (5'-D(*TP*GP*AP*TP*AP*TP*GP*TP*TP*GP*TP*AP*AP*CP*TP*A)-3')

Chain C:

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α, β, γ	64.50Å 64.50Å 250.94Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	62.74 – 2.35 28.68 – 2.35	Depositor EDS
% Data completeness (in resolution range)	99.3 (62.74-2.35) 99.4 (28.68-2.35)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.99 (at 2.36Å)	Xtriage
Refinement program	REFMAC 5.8.0073	Depositor
R, R_{free}	0.220 , 0.266 0.226 , 0.234	Depositor DCC
R_{free} test set	1181 reflections (5.14%)	wwPDB-VP
Wilson B-factor (Å^2)	54.3	Xtriage
Anisotropy	0.365	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.30 , 31.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	3184	wwPDB-VP
Average B, all atoms (Å^2)	62.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.81% of the height of the origin peak. No significant pseudotranslation is detected.*

[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ 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: IOD, EDO, MPD

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	0.71	0/2571	0.86	2/3495 (0.1%)
2	B	0.75	1/316 (0.3%)	1.06	2/485 (0.4%)
3	C	0.65	0/346	1.02	1/534 (0.2%)
All	All	0.70	1/3233 (0.0%)	0.90	5/4514 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	316	DA	O3'-P	-5.63	1.54	1.61

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	307	VAL	CB-CA-C	-6.18	99.66	111.40
2	B	311	DT	C5'-C4'-O4'	5.80	120.33	109.30
2	B	313	DG	O5'-P-OP2	-5.72	100.56	105.70
3	C	327	DT	C5'-C4'-O4'	5.07	118.93	109.30
1	A	222	LEU	CB-CG-CD1	5.06	119.61	111.00

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	2509	0	2523	45	0
2	B	282	0	160	3	0
3	C	310	0	173	2	0
4	A	2	0	0	2	0
5	A	8	0	14	0	0
6	A	4	0	6	1	0
7	A	50	0	0	1	0
7	B	10	0	0	0	0
7	C	9	0	0	0	0
All	All	3184	0	2876	46	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 8.

All (46) 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:204[A]:THR:CG2	1:A:205[A]:ARG:H	1.56	1.17
1:A:204[A]:THR:HG22	1:A:205[A]:ARG:H	1.02	1.14
1:A:210[B]:ARG:HG2	1:A:210[B]:ARG:HH11	0.98	1.07
1:A:204[A]:THR:HG22	1:A:205[A]:ARG:N	1.67	1.06
1:A:80:GLN:HE21	1:A:80:GLN:H	1.09	0.94
1:A:210[B]:ARG:HG2	1:A:210[B]:ARG:NH1	1.71	0.92
1:A:210[B]:ARG:HH11	1:A:210[B]:ARG:CG	1.86	0.89
1:A:204[A]:THR:CG2	1:A:205[A]:ARG:N	2.27	0.84
1:A:297:ARG:NH1	4:A:402:IOD:I	2.81	0.83
1:A:215:GLU:OE1	1:A:302:ARG:NH1	2.17	0.76
1:A:210[A]:ARG:NH1	1:A:213:GLU:OE1	2.19	0.74
1:A:204[B]:THR:N	1:A:207:GLU:OE2	2.22	0.73
1:A:201:ALA:HB1	1:A:202:PRO:CD	2.24	0.68
1:A:80:GLN:H	1:A:80:GLN:NE2	1.89	0.68
1:A:288:ARG:HD2	2:B:311:DT:O2	1.93	0.67
1:A:204[A]:THR:HG23	1:A:205[A]:ARG:H	1.60	0.60
1:A:80:GLN:HE21	1:A:80:GLN:N	1.90	0.59
1:A:265:ARG:NH1	4:A:401:IOD:I	3.05	0.59
1:A:199:SER:OG	1:A:204[A]:THR:HG23	2.02	0.58
1:A:199:SER:O	1:A:200:VAL:HB	2.01	0.58
1:A:80:GLN:HE22	1:A:149:GLY:HA3	1.68	0.57
1:A:200:VAL:HG11	1:A:208:TRP:CE3	2.41	0.55
1:A:204[B]:THR:O	1:A:205[B]:ARG:CB	2.55	0.54
1:A:20:GLU:OE2	1:A:113:HIS:HE1	1.90	0.54
1:A:299:ILE:HD13	1:A:307:VAL:HG22	1.90	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:204[A]:THR:O	1:A:205[A]:ARG:C	2.49	0.51
2:B:324:DC:C4	3:C:328:DG:O6	2.64	0.51
1:A:201:ALA:CB	1:A:202:PRO:CD	2.89	0.50
1:A:31:HIS:HD2	1:A:101:GLN:O	1.95	0.49
1:A:201:ALA:HB1	1:A:202:PRO:HD3	1.94	0.49
1:A:187:LEU:HD13	1:A:219:ILE:CG2	2.43	0.49
1:A:289:TYR:CE1	3:C:341:DT:H4'	2.49	0.47
1:A:43:GLU:HG3	1:A:86:ARG:CZ	2.44	0.47
1:A:99:CYS:SG	1:A:272:PRO:HG2	2.55	0.46
1:A:37:ARG:NH1	1:A:276:GLU:HB3	2.31	0.46
1:A:214:ARG:NH1	1:A:218:ASP:OD1	2.50	0.45
1:A:142:TRP:HE1	6:A:404:EDO:H22	1.82	0.44
1:A:187:LEU:HD13	1:A:219:ILE:HG22	1.97	0.44
1:A:203[A]:TRP:CZ2	1:A:211:LYS:HE3	2.55	0.42
1:A:180:ASN:OD1	2:B:317:DC:H5'	2.20	0.41
1:A:210[A]:ARG:HA	1:A:210[A]:ARG:HD3	1.94	0.41
1:A:6:LEU:HD11	1:A:131:GLU:HB3	2.03	0.41
1:A:151:ILE:O	1:A:154:ASN:HB2	2.20	0.41
1:A:293:ALA:HB1	7:A:504:HOH:O	2.21	0.41
1:A:28:LEU:HD22	1:A:100:TYR:CE2	2.56	0.40
1:A:164:ASP:N	1:A:165:PRO:CD	2.84	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	308/316 (98%)	293 (95%)	9 (3%)	6 (2%)	8 6

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	197	PRO
1	A	201	ALA
1	A	205[A]	ARG
1	A	205[B]	ARG
1	A	49	GLU
1	A	200	VAL

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	268/279 (96%)	227 (85%)	41 (15%)	2 2

All (41) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	6	LEU
1	A	8	ASP
1	A	15	ARG
1	A	21	LEU
1	A	28	LEU
1	A	35	VAL
1	A	53	LEU
1	A	55	ARG
1	A	59	LYS
1	A	69	LEU
1	A	71	LEU
1	A	77	LEU
1	A	80	GLN
1	A	83	SER
1	A	85	ASN
1	A	88	SER
1	A	98	LEU
1	A	112	SER
1	A	113	HIS
1	A	159	LEU
1	A	168	LEU

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Mol	Chain	Res	Type
1	A	177	ILE
1	A	187	LEU
1	A	192	LYS
1	A	195	LYS
1	A	196	SER
1	A	199	SER
1	A	200	VAL
1	A	203[A]	TRP
1	A	203[B]	TRP
1	A	210[A]	ARG
1	A	210[B]	ARG
1	A	214	ARG
1	A	222	LEU
1	A	249	LYS
1	A	255	CYS
1	A	265	ARG
1	A	294	GLN
1	A	302	ARG
1	A	305	LEU
1	A	307	VAL

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

Mol	Chain	Res	Type
1	A	31	HIS
1	A	60	GLN
1	A	64	ASN
1	A	80	GLN
1	A	85	ASN
1	A	113	HIS
1	A	116	HIS
1	A	180	ASN
1	A	294	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 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 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	$\#\|Z\| > 2$
6	EDO	A	404	-	3,3,3	0.51	0	2,2,2	0.46	0
5	MPD	A	403	-	7,7,7	0.86	0	9,10,10	2.16	3 (33%)

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
6	EDO	A	404	-	-	0/1/1/1	-
5	MPD	A	403	-	-	0/5/5/5	-

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	A	403	MPD	O2-C2-C3	-3.95	94.96	109.80
5	A	403	MPD	CM-C2-C1	-3.46	103.36	110.57
5	A	403	MPD	O2-C2-CM	2.58	116.36	108.08

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	A	404	EDO	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, 95th 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^2)	Q<0.9
1	A	305/316 (96%)	0.05	15 (4%)	29	42	39, 55, 97, 148	0
2	B	14/16 (87%)	-0.11	1 (7%)	16	23	46, 53, 80, 83	1 (7%)
3	C	16/16 (100%)	0.26	2 (12%)	3	6	41, 56, 120, 133	1 (6%)
All	All	335/348 (96%)	0.05	18 (5%)	25	37	39, 55, 104, 148	2 (0%)

All (18) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	C	327	DT	4.7
1	A	289	TYR	4.2
1	A	202	PRO	3.8
1	A	84	GLU	3.7
1	A	204[A]	THR	3.7
1	A	203[A]	TRP	3.5
1	A	50	HIS	3.2
1	A	199	SER	3.2
1	A	195	LYS	3.0
2	B	324	DC	2.9
1	A	6	LEU	2.8
1	A	309	ASP	2.6
1	A	288	ARG	2.5
1	A	85	ASN	2.5
1	A	197	PRO	2.3
3	C	328	DG	2.2
1	A	268	GLY	2.0
1	A	201	ALA	2.0

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, 95th 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^2)	Q<0.9
5	MPD	A	403	8/8	0.83	0.39	49,55,59,65	0
6	EDO	A	404	4/4	0.92	0.11	59,59,61,67	0
4	IOD	A	401	1/1	1.00	0.12	57,57,57,57	0
4	IOD	A	402	1/1	1.00	0.09	60,60,60,60	1

6.5 Other polymers (i)

There are no such residues in this entry.