wwPDB X-ray Structure Validation Summary Report (i)

Feb 18, 2024 – 07:16 PM EST

PDB ID	:	4HDR
Title	:	Crystal Structure of ArsAB in Complex with 5,6-dimethylbenzimidazole
Authors	:	Newmister, S.A.; Chan, C.H.; Escalante-Semerena, J.C.; Rayment, I.
Deposited on	:	2012-10-02
Resolution	:	1.45 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*
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:

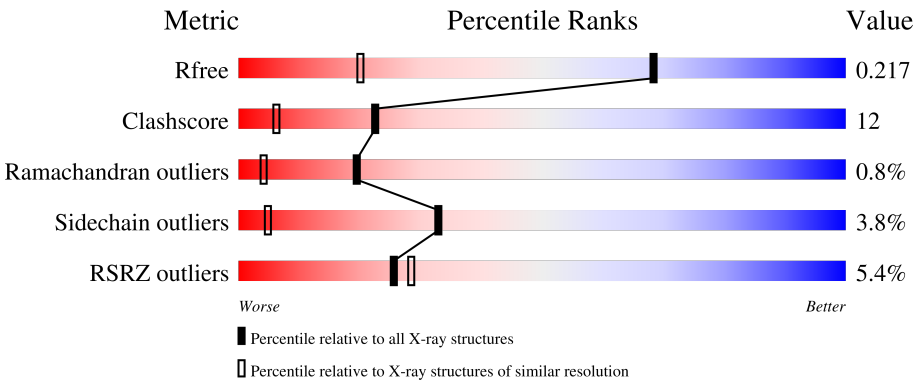
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA,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

1 Overall quality at a glance (i)

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

The reported resolution of this entry is 1.45 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	1156 (1.46-1.46)
Clashscore	141614	1202 (1.46-1.46)
Ramachandran outliers	138981	1178 (1.46-1.46)
Sidechain outliers	138945	1178 (1.46-1.46)
RSRZ outliers	127900	1139 (1.46-1.46)

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	348	5% 80% 13% • •
1	C	348	5% 80% 12% • • 5%
2	B	350	4% 75% 17% • 6%
2	D	350	5% 76% 15% • • 6%

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
4	EDO	B	402	-	-	X	-
4	EDO	C	803	-	-	X	-
4	EDO	D	402	-	-	X	-
4	EDO	D	403	-	-	X	-
4	EDO	D	405	-	-	X	-

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 11158 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 ArsA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	335	2522	1590	441	471	20	0	11	0
1	C	331	2492	1571	436	466	19	0	11	0

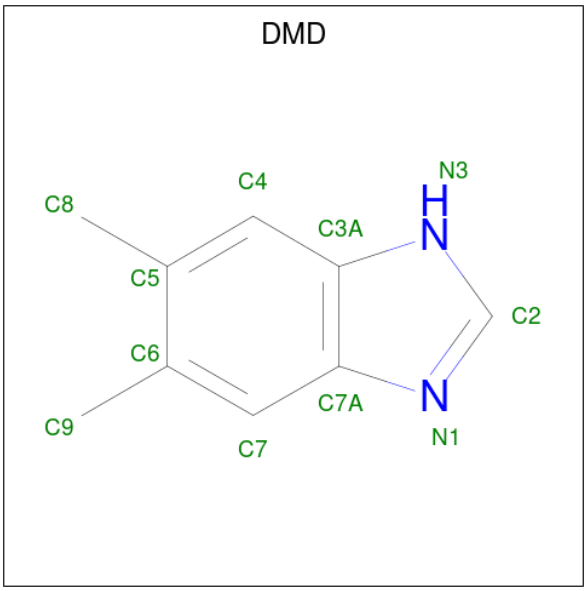
There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	GLY	-	expression tag	UNP F6MZ55
A	0	GLY	-	expression tag	UNP F6MZ55
C	-1	GLY	-	expression tag	UNP F6MZ55
C	0	GLY	-	expression tag	UNP F6MZ55

- Molecule 2 is a protein called ArsB.

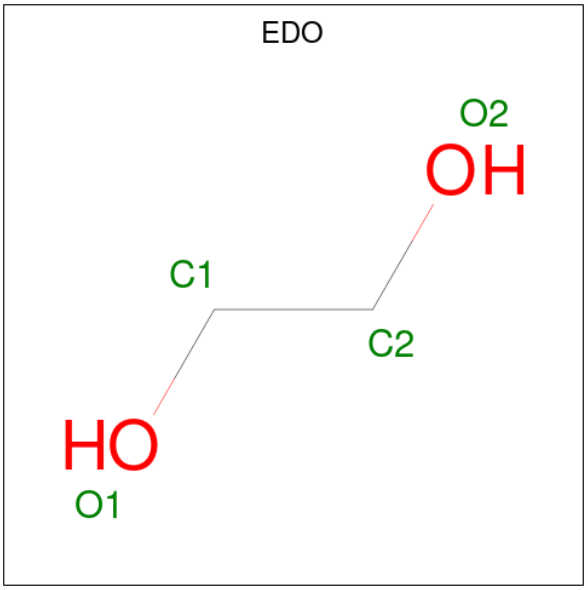
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	329	2440	1542	430	442	26	0	15	0
2	D	328	2439	1547	427	439	26	0	17	0

- Molecule 3 is 5,6-DIMETHYLBENZIMIDAZOLE (three-letter code: DMD) (formula: $C_9H_{10}N_2$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C N 11 9 2	0	0
3	C	1	Total C N 11 9 2	0	0

- Molecule 4 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).



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

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

- Molecule 5 is water.

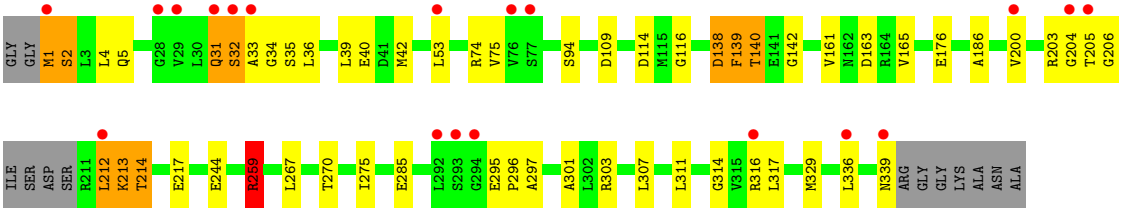
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
5	A	245	245	245	0	0
			Total	O		
5	B	365	365	365	0	0
			Total	O		
5	C	240	240	240	0	0
			Total	O		
5	D	341	341	341	0	0

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.

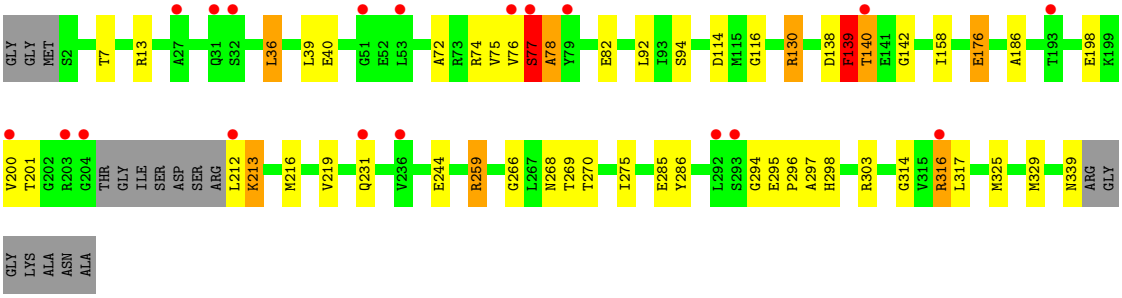
- Molecule 1: ArsA

Chain A:



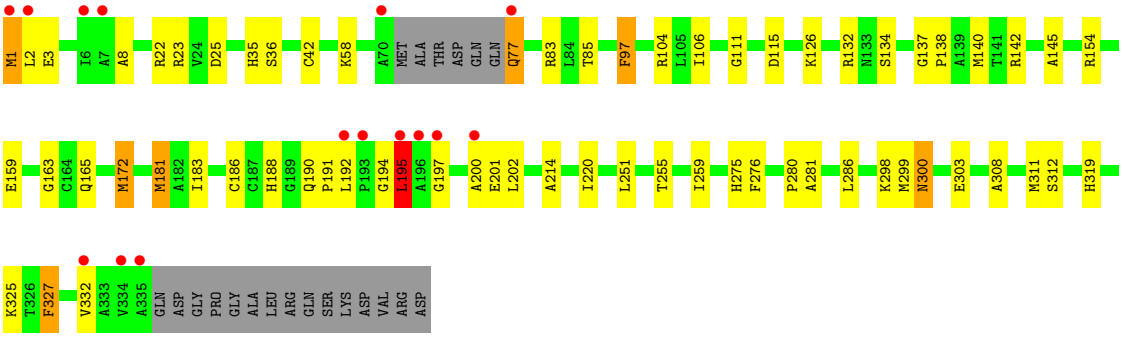
- Molecule 1: ArsA

Chain C:



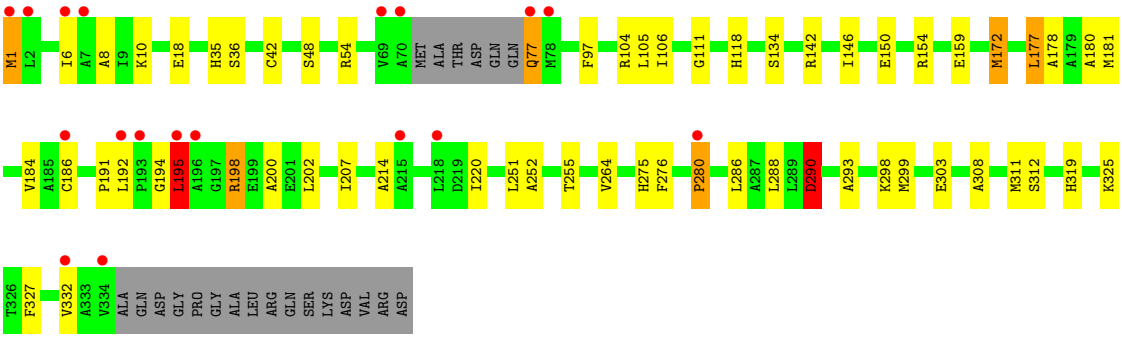
- Molecule 2: ArsB

Chain B:



• Molecule 2: ArsB

Chain D:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	52.73Å 77.39Å 152.27Å 90.00° 90.17° 90.00°	Depositor
Resolution (Å)	50.00 – 1.45 43.29 – 1.45	Depositor EDS
% Data completeness (in resolution range)	97.3 (50.00-1.45) 96.6 (43.29-1.45)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	6.23 (at 1.45Å)	Xtriage
Refinement program	REFMAC 5.6.0117	Depositor
R, R_{free}	0.186 , 0.219 0.186 , 0.217	Depositor DCC
R_{free} test set	10597 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å^2)	16.0	Xtriage
Anisotropy	0.464	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.31 , 27.8	EDS
L-test for twinning[2]	$< \|L\| > = 0.51$, $< L^2 > = 0.35$	Xtriage
Estimated twinning fraction	0.477 for h,-k,-l	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	11158	wwPDB-VP
Average B, all atoms (Å^2)	23.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.56% 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: EDO, DMD

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	1.12	2/2576 (0.1%)	1.19	8/3489 (0.2%)
1	C	1.14	3/2547 (0.1%)	1.19	11/3452 (0.3%)
2	B	1.19	1/2506 (0.0%)	1.28	18/3397 (0.5%)
2	D	1.19	4/2520 (0.2%)	1.28	12/3416 (0.4%)
All	All	1.16	10/10149 (0.1%)	1.24	49/13754 (0.4%)

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
1	C	0	1
All	All	0	2

The worst 5 of 10 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	244	GLU	CD-OE1	6.05	1.32	1.25
2	D	48	SER	CA-CB	-5.96	1.44	1.52
2	D	36	SER	CB-OG	5.95	1.50	1.42
2	D	290	ASP	CB-CG	-5.94	1.39	1.51
2	D	134	SER	CB-OG	-5.87	1.34	1.42

The worst 5 of 49 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	D	290	ASP	CB-CG-OD2	-10.43	108.92	118.30
1	A	244	GLU	OE1-CD-OE2	-8.69	112.87	123.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	C	244	GLU	OE1-CD-OE2	-8.44	113.18	123.30
1	C	130[A]	ARG	NE-CZ-NH1	-8.20	116.20	120.30
1	C	130[B]	ARG	NE-CZ-NH1	-8.20	116.20	120.30

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	204	GLY	Peptide
1	C	77	SER	Peptide

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	2522	0	2615	58	0
1	C	2492	0	2574	58	0
2	B	2440	0	2579	56	0
2	D	2439	0	2597	69	1
3	A	11	0	10	2	0
3	C	11	0	10	2	0
4	A	4	0	6	0	0
4	B	20	0	30	11	0
4	C	8	0	12	7	0
4	D	20	0	30	27	0
5	A	245	0	0	5	0
5	B	365	0	0	17	1
5	C	240	0	0	9	0
5	D	341	0	0	10	0
All	All	11158	0	10463	237	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 12.

The worst 5 of 237 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:C:294:GLY:HA2	1:C:316[A]:ARG:HD2	1.23	1.19
1:C:36:LEU:CD2	1:C:40:GLU:HB2	1.75	1.16
2:D:290:ASP:HB2	4:D:405:EDO:H22	1.29	1.15
4:D:402:EDO:H11	5:D:591:HOH:O	1.42	1.14
1:C:270[B]:THR:HG21	1:C:298[B]:HIS:NE2	1.62	1.13

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)
2:D:290:ASP:OD2	5:B:538:HOH:O[1_465]	1.93	0.27

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	342/348 (98%)	323 (94%)	15 (4%)	4 (1%)	13 2
1	C	338/348 (97%)	324 (96%)	12 (4%)	2 (1%)	25 7
2	B	340/350 (97%)	330 (97%)	8 (2%)	2 (1%)	25 7
2	D	341/350 (97%)	332 (97%)	6 (2%)	3 (1%)	17 3
All	All	1361/1396 (98%)	1309 (96%)	41 (3%)	11 (1%)	19 4

5 of 11 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	31	GLN
1	C	78	ALA
1	A	116	GLY
2	B	35	HIS
1	C	116	GLY

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	268/264 (102%)	258 (96%)	10 (4%)	34	5
1	C	265/264 (100%)	255 (96%)	10 (4%)	33	5
2	B	253/256 (99%)	242 (96%)	11 (4%)	29	3
2	D	255/256 (100%)	246 (96%)	9 (4%)	36	6
All	All	1041/1040 (100%)	1001 (96%)	40 (4%)	33	5

5 of 40 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	285	GLU
2	D	195	LEU
1	C	316[A]	ARG
2	D	77	GLN
2	D	202	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 14 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	277	ASN
1	C	306	GLN
2	D	275	HIS
2	D	91	GLN
2	D	262	ASN

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)

15 ligands are 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	$\#\|Z\| > 2$
4	EDO	B	401	-	3,3,3	0.97	0	2,2,2	0.69	0
4	EDO	C	802	-	3,3,3	0.80	0	2,2,2	0.77	0
4	EDO	C	803	-	3,3,3	0.19	0	2,2,2	1.08	0
4	EDO	D	403	-	3,3,3	0.82	0	2,2,2	0.57	0
4	EDO	B	404	-	3,3,3	0.98	0	2,2,2	1.40	0
4	EDO	D	404	-	3,3,3	1.04	0	2,2,2	0.31	0
4	EDO	B	403	-	3,3,3	0.30	0	2,2,2	0.77	0
4	EDO	A	802	-	3,3,3	0.75	0	2,2,2	0.45	0
4	EDO	D	405	-	3,3,3	0.41	0	2,2,2	1.31	0
3	DMD	C	801	-	10,12,12	1.46	1 (10%)	10,17,17	1.60	2 (20%)
4	EDO	B	405	-	3,3,3	1.16	0	2,2,2	0.46	0
4	EDO	D	402	-	3,3,3	0.72	0	2,2,2	1.47	0
4	EDO	B	402	-	3,3,3	0.83	0	2,2,2	0.99	0
3	DMD	A	801	-	10,12,12	1.43	2 (20%)	10,17,17	2.01	1 (10%)
4	EDO	D	401	-	3,3,3	1.00	0	2,2,2	0.41	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	EDO	B	401	-	-	1/1/1/1	-
4	EDO	C	802	-	-	1/1/1/1	-
4	EDO	C	803	-	-	1/1/1/1	-
4	EDO	D	403	-	-	1/1/1/1	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	EDO	D	404	-	-	0/1/1/1	-
4	EDO	B	403	-	-	0/1/1/1	-
4	EDO	A	802	-	-	1/1/1/1	-
4	EDO	D	405	-	-	0/1/1/1	-
4	EDO	B	402	-	-	1/1/1/1	-
3	DMD	C	801	-	-	-	0/2/2/2
4	EDO	B	405	-	-	1/1/1/1	-
4	EDO	D	402	-	-	1/1/1/1	-
4	EDO	B	404	-	-	1/1/1/1	-
3	DMD	A	801	-	-	-	0/2/2/2
4	EDO	D	401	-	-	1/1/1/1	-

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	801	DMD	C6-C5	3.75	1.50	1.40
3	A	801	DMD	C6-C5	3.39	1.49	1.40
3	A	801	DMD	C3A-C7A	2.25	1.50	1.42

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	A	801	DMD	C6-C7-C7A	-5.07	114.04	121.22
3	C	801	DMD	C5-C4-C3A	-3.52	116.23	121.22
3	C	801	DMD	C9-C6-C5	-2.30	116.03	120.74

There are no chirality outliers.

5 of 10 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	C	802	EDO	O1-C1-C2-O2
4	A	802	EDO	O1-C1-C2-O2
4	C	803	EDO	O1-C1-C2-O2
4	B	404	EDO	O1-C1-C2-O2
4	B	402	EDO	O1-C1-C2-O2

There are no ring outliers.

10 monomers are involved in 49 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	B	401	EDO	1	0

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Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	C	803	EDO	7	0
4	D	403	EDO	11	0
4	B	404	EDO	3	0
4	D	405	EDO	7	0
3	C	801	DMD	2	0
4	D	402	EDO	8	0
4	B	402	EDO	7	0
3	A	801	DMD	2	0
4	D	401	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	335/348 (96%)	0.57	19 (5%)	23	26	11, 21, 40, 88	0
1	C	331/348 (95%)	0.58	19 (5%)	23	26	12, 21, 39, 84	0
2	B	329/350 (94%)	0.31	15 (4%)	32	35	9, 16, 41, 73	0
2	D	328/350 (93%)	0.28	18 (5%)	25	28	9, 15, 41, 83	0
All	All	1323/1396 (94%)	0.44	71 (5%)	25	28	9, 18, 40, 88	0

The worst 5 of 71 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	33	ALA	6.8
2	B	334	VAL	6.7
2	B	196	ALA	6.4
2	D	334	VAL	5.8
1	A	212	LEU	5.7

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
4	EDO	A	802	4/4	0.59	0.30	37,39,39,44	0
4	EDO	B	404	4/4	0.65	0.35	28,35,36,36	0
4	EDO	B	402	4/4	0.73	0.27	24,24,27,39	0
4	EDO	B	403	4/4	0.75	0.17	41,45,47,47	0
4	EDO	D	405	4/4	0.77	0.39	29,31,34,35	0
4	EDO	D	401	4/4	0.78	0.16	23,27,29,30	0
4	EDO	C	802	4/4	0.78	0.18	34,34,35,38	0
4	EDO	B	401	4/4	0.83	0.12	23,27,29,30	0
3	DMD	C	801	11/11	0.87	0.15	19,22,23,24	0
4	EDO	D	402	4/4	0.88	0.23	19,23,29,29	0
4	EDO	D	403	4/4	0.89	0.27	22,22,30,38	0
4	EDO	B	405	4/4	0.89	0.10	23,24,26,27	0
4	EDO	C	803	4/4	0.90	0.27	19,22,36,38	0
3	DMD	A	801	11/11	0.92	0.12	20,22,24,25	0
4	EDO	D	404	4/4	0.93	0.13	23,26,27,30	0

6.5 Other polymers (i)

There are no such residues in this entry.