



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2026 – 11:46 PM UTC

PDB ID : 2HSE / pdb_00002hse
Title : Structure of D236A E. coli Aspartate Transcarbamoylase in the presence of phosphonoacetamide and l-Aspartate at 2.60 Å resolution
Authors : Wang, J.; Kantrowitz, E.R.
Deposited on : 2006-07-21
Resolution : 2.60 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 ⓘ 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 ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

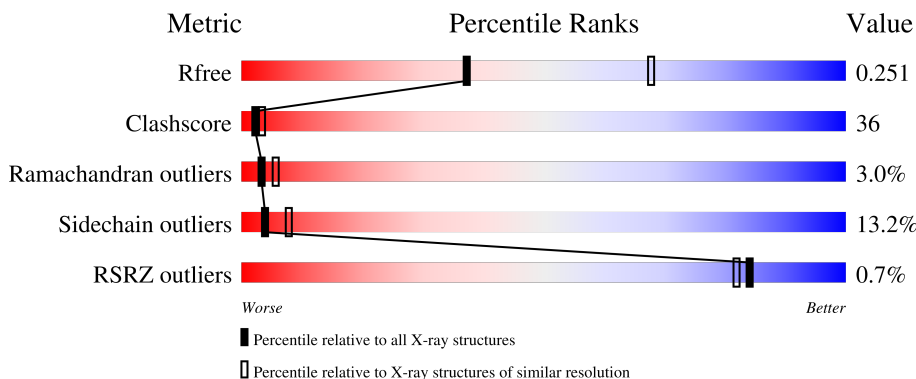
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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}	180053	4008 (2.60-2.60)
Clashscore	190562	4347 (2.60-2.60)
Ramachandran outliers	187476	4277 (2.60-2.60)
Sidechain outliers	187428	4277 (2.60-2.60)
RSRZ outliers	180081	4008 (2.60-2.60)

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 $\leq 5\%$. 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	310	
1	C	310	
2	B	153	
2	D	153	

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
5	ASP	A	813	-	-	X	-

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 7509 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 Aspartate carbamoyltransferase catalytic chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	310	Total	C	N	O	S	0	0	0
			2412	1526	423	454	9			
1	C	310	Total	C	N	O	S	0	0	0
			2412	1526	423	454	9			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	236	ALA	ASP	engineered mutation	UNP P0A786
C	236	ALA	ASP	engineered mutation	UNP P0A786

- Molecule 2 is a protein called Aspartate carbamoyltransferase regulatory chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	146	Total	C	N	O	S	0	0	0
			1143	717	202	219	5			
2	D	146	Total	C	N	O	S	0	0	0
			1143	717	202	219	5			

There are 2 discrepancies between the modelled and reference sequences:

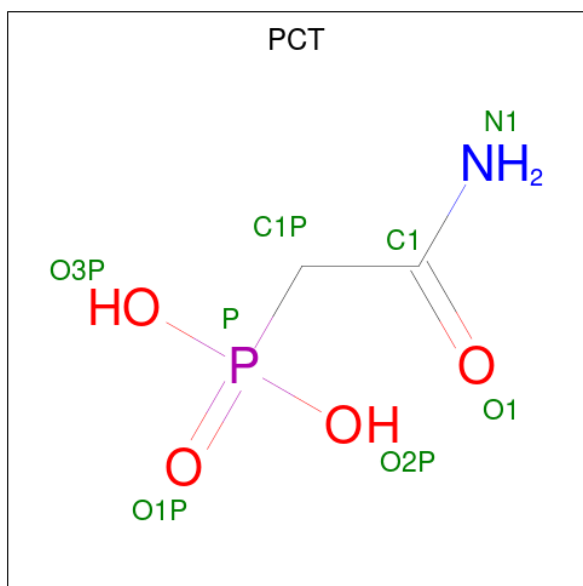
Chain	Residue	Modelled	Actual	Comment	Reference
B	1	MET	-	initiating methionine	UNP P0A7F3
D	1	MET	-	initiating methionine	UNP P0A7F3

- Molecule 3 is PHOSPHATE ION (CCD ID: PO4) (formula: O₄P).



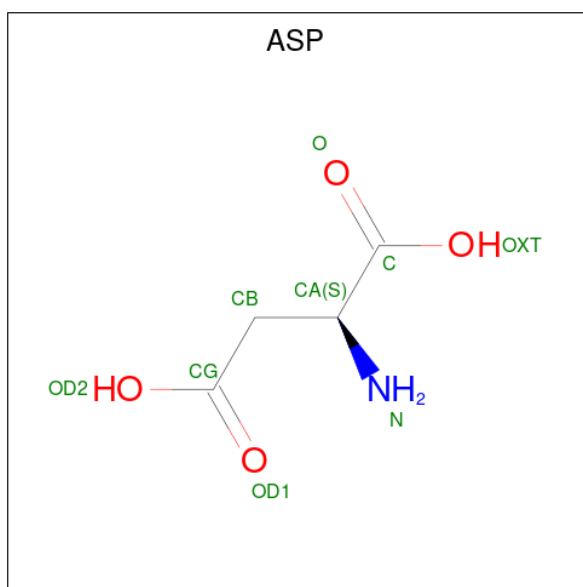
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	O	P		
3	A	1	5	4	1	0	0

- Molecule 4 is PHOSPHONOACETAMIDE (CCD ID: PCT) (formula: C₂H₆NO₄P).



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

- Molecule 5 is ASPARTIC ACID (CCD ID: ASP) (formula: C₄H₇NO₄).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	A	1	Total	C	N	O	0	0
			9	4	1	4		
5	A	1	Total	C	N	O	0	0
			9	4	1	4		
5	C	1	Total	C	N	O	0	0
			9	4	1	4		

- Molecule 6 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	B	1	Total	Zn	0	0
			1	1		
6	D	1	Total	Zn	0	0
			1	1		

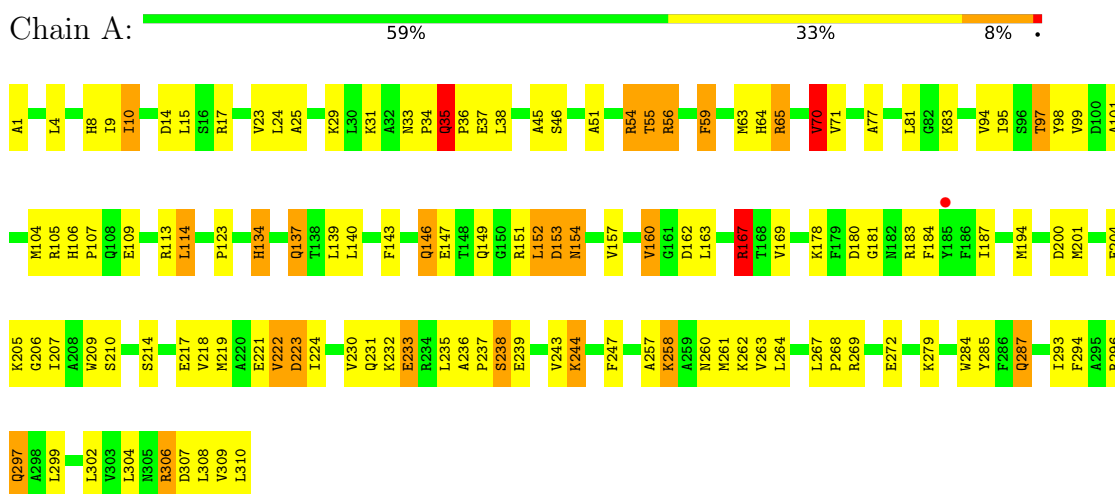
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	134	Total	O	0	0
			134	134		
7	B	57	Total	O	0	0
			57	57		
7	C	123	Total	O	0	0
			123	123		
7	D	35	Total	O	0	0
			35	35		

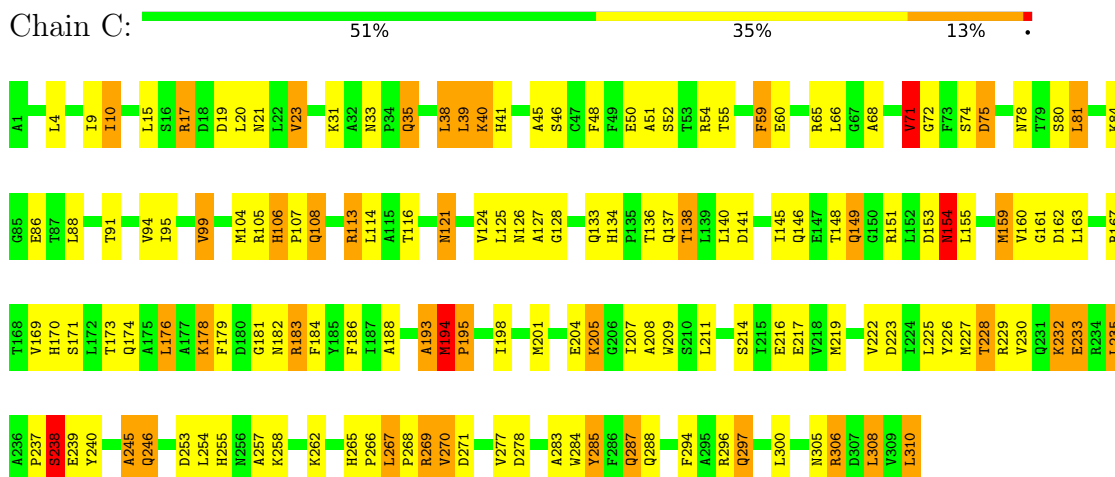
3 Residue-property plots

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: Aspartate carbamoyltransferase catalytic chain

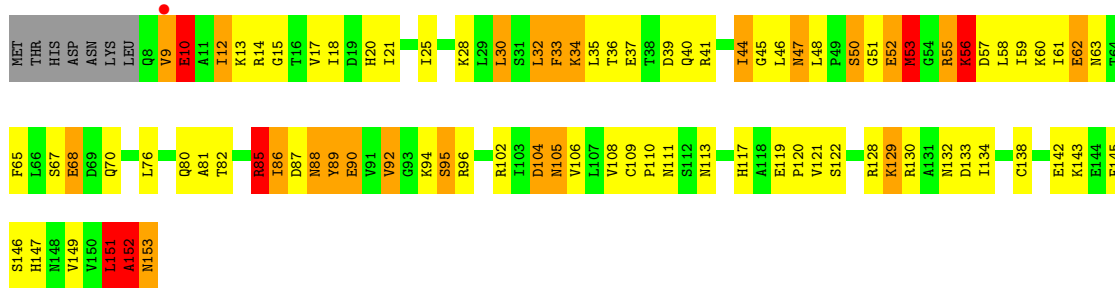


- Molecule 1: Aspartate carbamoyltransferase catalytic chain

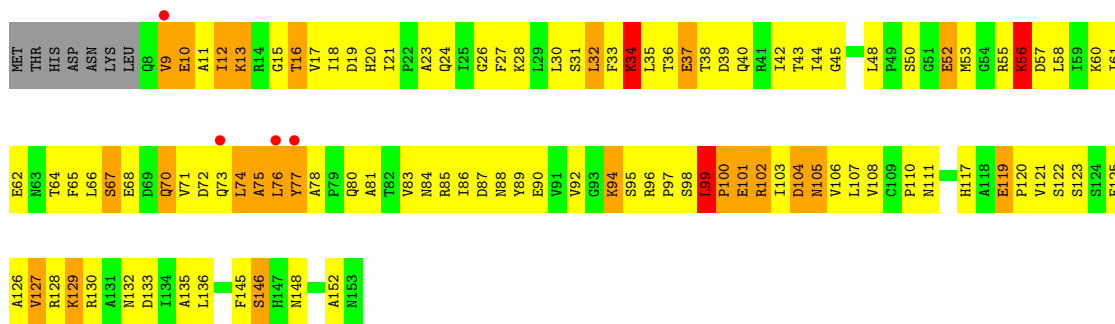


- Molecule 2: Aspartate carbamoyltransferase regulatory chain





• Molecule 2: Aspartate carbamoyltransferase regulatory chain



4 Data and refinement statistics i

Property	Value	Source
Space group	P 3 2 1	Depositor
Cell constants a, b, c, α , β , γ	121.08Å 121.08Å 155.24Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	30.00 – 2.60 30.00 – 2.60	Depositor EDS
% Data completeness (in resolution range)	(Not available) (30.00-2.60) 96.8 (30.00-2.60)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.04 (at 2.57Å)	Xtrriage
Refinement program	CNS	Depositor
R, R_{free}	0.209 , 0.254 0.208 , 0.251	Depositor DCC
R_{free} test set	4038 reflections (10.07%)	wwPDB-VP
Wilson B-factor (Å ²)	64.2	Xtrriage
Anisotropy	0.246	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.28 , 43.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	0.029 for -h,-k,l	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	7509	wwPDB-VP
Average B, all atoms (Å ²)	72.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.12% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: ZN, PCT, PO4

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	0.53	0/2458	1.09	20/3335 (0.6%)
1	C	0.49	0/2458	1.12	18/3335 (0.5%)
2	B	0.62	1/1160 (0.1%)	1.14	14/1568 (0.9%)
2	D	0.39	0/1160	0.97	6/1568 (0.4%)
All	All	0.51	1/7236 (0.0%)	1.09	58/9806 (0.6%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	50	SER	CA-C	5.84	1.56	1.52

The worst 5 of 58 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	193	ALA	N-CA-C	11.18	124.57	111.71
1	C	35	GLN	CA-C-N	10.34	131.46	119.47
1	C	35	GLN	C-N-CA	10.34	131.46	119.47
1	A	308	LEU	N-CA-C	-8.30	100.20	110.41
1	C	222	VAL	N-CA-C	7.89	119.94	109.21

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	2412	0	2423	126	0
1	C	2412	0	2423	179	0
2	B	1143	0	1159	93	0
2	D	1143	0	1159	127	0
3	A	5	0	0	0	0
4	A	8	0	4	3	0
4	C	8	0	4	0	0
5	A	18	0	6	11	0
5	C	9	0	3	2	0
6	B	1	0	0	0	0
6	D	1	0	0	0	0
7	A	134	0	0	31	0
7	B	57	0	0	12	0
7	C	123	0	0	40	0
7	D	35	0	0	19	0
All	All	7509	0	7181	515	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 36.

The worst 5 of 515 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)
2:B:55:ARG:HB2	2:B:55:ARG:NH2	1.70	1.07
2:B:55:ARG:HB2	2:B:55:ARG:HH21	0.95	1.06
1:C:138:THR:HG22	7:C:317:HOH:O	1.58	1.02
1:A:31:LYS:HG3	7:A:436:HOH:O	1.62	0.98
1:A:54:ARG:HB3	5:A:813:ASP:HB2	1.45	0.97

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	308/310 (99%)	292 (95%)	15 (5%)	1 (0%)	36	58
1	C	308/310 (99%)	278 (90%)	23 (8%)	7 (2%)	5	9
2	B	144/153 (94%)	108 (75%)	28 (19%)	8 (6%)	1	1
2	D	144/153 (94%)	103 (72%)	30 (21%)	11 (8%)	1	1
All	All	904/926 (98%)	781 (86%)	96 (11%)	27 (3%)	3	6

5 of 27 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	238	SER
2	B	32	LEU
2	B	53	MET
2	B	152	ALA
1	C	154	ASN

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	260/260 (100%)	234 (90%)	26 (10%)	7	16
1	C	260/260 (100%)	222 (85%)	38 (15%)	3	6
2	B	130/137 (95%)	109 (84%)	21 (16%)	2	4
2	D	130/137 (95%)	112 (86%)	18 (14%)	3	7
All	All	780/794 (98%)	677 (87%)	103 (13%)	4	8

5 of 103 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	75	ASP
1	C	211	LEU
2	D	101	GLU
1	C	108	GLN
1	C	159	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 37 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	291	ASN
2	D	147	HIS
1	C	297	GLN
2	D	24	GLN
2	B	40	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 8 ligands modelled in this entry, 2 are monoatomic - leaving 6 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	$\# Z > 2$
5	ASP	A	812	-	7,8,8	1.23	1 (14%)	6,10,10	1.19	1 (16%)
4	PCT	C	911	-	7,7,7	1.69	2 (28%)	9,10,10	0.74	0
4	PCT	A	811	-	7,7,7	1.85	2 (28%)	9,10,10	0.74	0
3	PO4	A	914	-	4,4,4	1.66	0	6,6,6	0.47	0
5	ASP	C	912	-	7,8,8	1.07	0	6,10,10	1.07	0
5	ASP	A	813	-	7,8,8	0.98	0	6,10,10	1.02	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
5	ASP	A	812	-	-	3/8/8/8	-
4	PCT	C	911	-	-	3/4/5/5	-
4	PCT	A	811	-	-	1/4/5/5	-
5	ASP	C	912	-	-	2/8/8/8	-
5	ASP	A	813	-	-	0/8/8/8	-

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	811	PCT	P-O2P	3.04	1.61	1.55
4	A	811	PCT	P-O3P	3.04	1.61	1.55
4	C	911	PCT	P-O3P	2.84	1.61	1.55
4	C	911	PCT	P-O2P	2.80	1.61	1.55
5	A	812	ASP	OD2-CG	-2.02	1.24	1.30

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	812	ASP	OD1-CG-CB	-2.11	116.36	122.84

There are no chirality outliers.

5 of 9 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	C	911	PCT	C1-C1P-P-O1P
4	C	911	PCT	C1-C1P-P-O2P
4	C	911	PCT	C1-C1P-P-O3P
5	C	912	ASP	OXT-C-CA-N
5	C	912	ASP	O-C-CA-N

There are no ring outliers.

4 monomers are involved in 16 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	812	ASP	3	0
4	A	811	PCT	3	0
5	C	912	ASP	2	0

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Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	813	ASP	8	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	310/310 (100%)	-0.39	1 (0%) 90 88	36, 56, 81, 108	0
1	C	310/310 (100%)	-0.31	0 100 100	50, 67, 87, 103	0
2	B	146/153 (95%)	-0.00	1 (0%) 84 82	46, 79, 114, 128	0
2	D	146/153 (95%)	0.21	4 (2%) 56 50	67, 101, 128, 153	0
All	All	912/926 (98%)	-0.21	6 (0%) 84 82	36, 69, 114, 153	0

The worst 5 of 6 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	D	77	TYR	3.5
2	D	9	VAL	3.4
2	B	9	VAL	3.3
2	D	76	LEU	3.1
2	D	73	GLN	2.7

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 oligosaccharides 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(\AA^2)	Q<0.9
5	ASP	A	813	9/9	0.76	0.23	106,106,107,108	0
3	PO4	A	914	5/5	0.78	0.12	117,117,118,118	0
5	ASP	C	912	9/9	0.84	0.19	90,94,97,99	0
5	ASP	A	812	9/9	0.86	0.16	64,66,67,68	0
4	PCT	C	911	8/8	0.96	0.06	54,57,61,61	0
4	PCT	A	811	8/8	0.97	0.06	36,41,43,47	0
6	ZN	B	954	1/1	0.99	0.02	53,53,53,53	0
6	ZN	D	955	1/1	1.00	0.02	80,80,80,80	0

6.5 Other polymers [i](#)

There are no such residues in this entry.