wwPDB X-ray Structure Validation Summary Report (i)

Aug 15, 2023 – 03:03 PM EDT

PDB ID	:	1SKU
Title	:	E. coli Aspartate Transcarbamylase 240's Loop Mutant (K244N)
Authors	:	Alam, N.; Stieglitz, K.A.; Caban, M.D.; Gourinath, S.; Tsuruta, H.; Kantrowitz, E.R.
Deposited on	:	2004-03-05
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 (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:

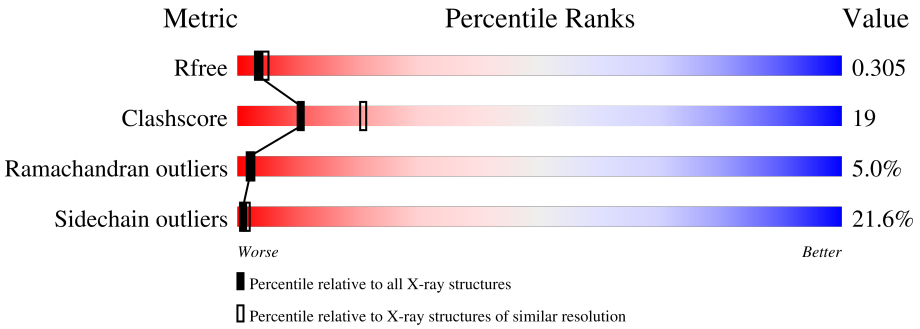
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35

1 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 2.60 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}	130704	3163 (2.60-2.60)
Clashscore	141614	3518 (2.60-2.60)
Ramachandran outliers	138981	3455 (2.60-2.60)
Sidechain outliers	138945	3455 (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 <=5%

Mol	Chain	Length	Quality of chain
1	A	310	76% 19%
1	C	310	73% 24%
2	B	153	53% 29% 12%
2	D	153	15% 50% 24% 7%

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 7229 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
1	A	310	Total	C	N	O	S	0	0	0
			2414	1525	423	457	9			
1	C	310	Total	C	N	O	S	0	0	0
			2414	1525	423	457	9			

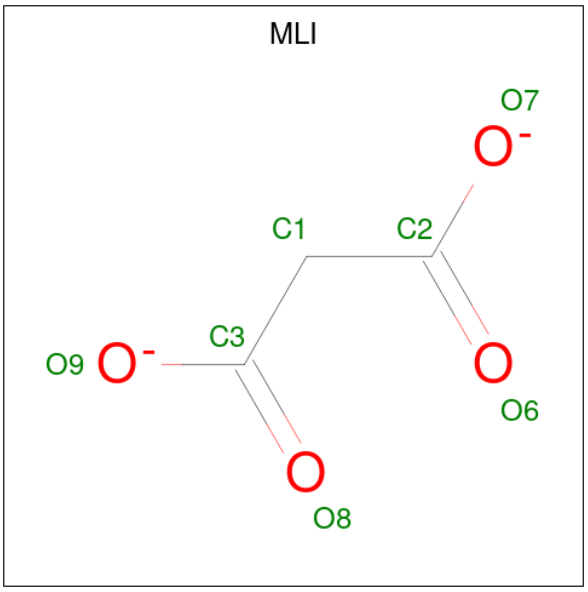
There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	244	ASN	LYS	engineered mutation	UNP P0A786
C	244	ASN	LYS	engineered mutation	UNP P0A786

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	148	Total	C	N	O	S	0	0	0
			1160	729	205	221	5			
2	D	148	Total	C	N	O	S	0	0	0
			1159	729	205	220	5			

- Molecule 3 is MALONATE ION (three-letter code: MLI) (formula: $C_3H_2O_4$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C O 7 3 4	0	0
3	C	1	Total C O 7 3 4	0	0

- Molecule 4 is ZINC ION (three-letter code: ZN) (formula: Zn).

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

- Molecule 5 is water.

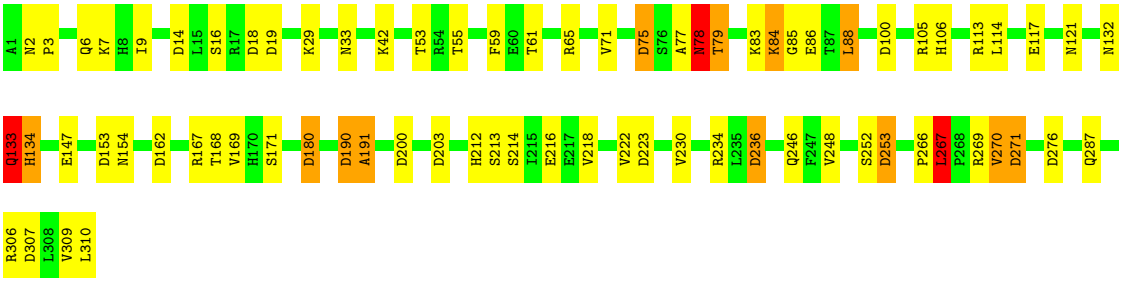
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	22	Total O 22 22	0	0
5	B	10	Total O 10 10	0	0
5	C	27	Total O 27 27	0	0
5	D	7	Total O 7 7	0	0

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. 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. 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

Chain A:

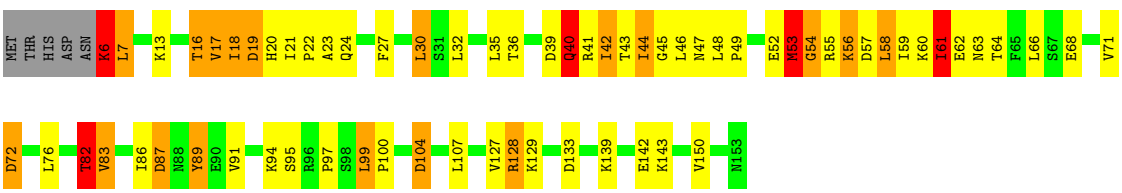


• Molecule 1: Aspartate carbamoyltransferase catalytic chain

Chain C:

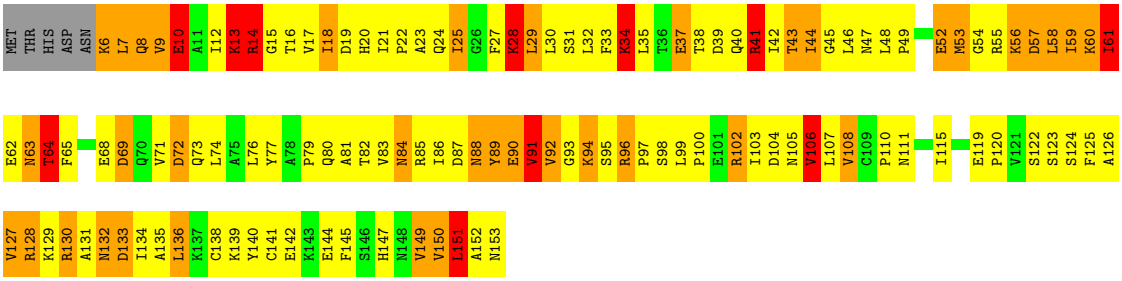
• Molecule 2: Aspartate carbamoyltransferase regulatory chain

Chain B:



• Molecule 2: Aspartate carbamoyltransferase regulatory chain

Chain D:


MET THR HIS ASP ASN K6 L7 Q8 V9 E10 A11 I12 K13 R14 G15 T16 V17 I18 D19 H20 I21 P22 A23 Q24 I25 G26 F27 K28 L29 L30 S31 L32 F33 K34 L35 T36 E37 T38 D39 Q40 R41 I42 T43 I44 G45 L46 M47 L48 P49 E52 M53 G54 R55 K56 D57 L58 I59 K60 I61
E62 N63 T64 F65 E68 D69 Q70 V71 D72 Q73 L74 A75 L76 Y77 A78 P79 Q80 A81 T82 V83 N84 R85 I86 D87 N88 Y89 E90 V91 V92 G93 K94 S95 R96 P97 S98 L99 P100 E101 R102 I103 D104 N105 V106 L107 V108 C109 P110 N111 I115 E119 P120 V121 S122 S123 S124 F125 A126
V127 R128 K129 R130 A131 N132 D133 I134 A135 L136 K137 C138 K139 Y140 C141 E142 K143 E144 F145 S146 H147 N148 V149 V150 L151 A152 N153

4 Data and refinement statistics (i)

Property	Value	Source
Space group	H 3	Depositor
Cell constants a, b, c, α, β, γ	125.67Å 125.67Å 198.20Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	29.55 – 2.60 31.80 – 2.50	Depositor EDS
% Data completeness (in resolution range)	89.4 (29.55-2.60) 85.4 (31.80-2.50)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.80 (at 2.51Å)	Xtriage
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.201 , 0.231 0.303 , 0.305	Depositor DCC
R_{free} test set	1720 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å^2)	46.1	Xtriage
Anisotropy	0.174	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.30 , -2.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.51$, $< L^2 > = 0.34$	Xtriage
Estimated twinning fraction	0.480 for h,-h-k,-l	Xtriage
F_o,F_c correlation	0.87	EDS
Total number of atoms	7229	wwPDB-VP
Average B, all atoms (Å^2)	34.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.80% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: MLI, ZN

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	0.54	6/2460 (0.2%)	0.79	21/3339 (0.6%)
1	C	0.39	1/2460 (0.0%)	0.79	16/3339 (0.5%)
2	B	0.54	1/1177 (0.1%)	1.00	13/1590 (0.8%)
2	D	0.57	4/1176 (0.3%)	0.83	4/1590 (0.3%)
All	All	0.50	12/7273 (0.2%)	0.83	54/9858 (0.5%)

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	2
1	C	0	1
2	B	0	2
2	D	0	2
All	All	0	7

The worst 5 of 12 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	134	HIS	C-N	14.82	1.62	1.34
2	D	14	ARG	C-N	-7.45	1.19	1.33
1	C	75	ASP	C-N	-6.84	1.18	1.34
1	A	191	ALA	C-N	6.66	1.49	1.34
2	B	83	VAL	C-N	6.56	1.49	1.34

The worst 5 of 54 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	C	267	LEU	C-N-CD	10.04	149.47	128.40
1	C	75	ASP	O-C-N	-9.18	108.01	122.70
2	D	14	ARG	O-C-N	-9.05	107.82	123.20
1	A	78	ASN	O-C-N	-8.94	108.39	122.70
2	D	28	LYS	O-C-N	-8.61	108.92	122.70

There are no chirality outliers.

5 of 7 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	133	GLN	Mainchain
1	A	78	ASN	Mainchain
2	B	6	LYS	Mainchain
2	B	87	ASP	Mainchain
1	C	75	ASP	Mainchain

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	2414	0	2412	21	0
1	C	2414	0	2413	32	0
2	B	1160	0	1185	44	0
2	D	1159	0	1181	185	0
3	A	7	0	2	0	0
3	C	7	0	2	0	0
4	B	1	0	0	0	0
4	D	1	0	0	0	0
5	A	22	0	0	1	0
5	B	10	0	0	3	0
5	C	27	0	0	2	0
5	D	7	0	0	0	0
All	All	7229	0	7195	267	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 19.

The worst 5 of 267 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:D:59:ILE:CD1	2:D:59:ILE:CG1	1.75	1.61
1:C:267:LEU:HD11	1:C:289:ALA:CB	1.51	1.37
1:A:75:ASP:HB3	1:A:78:ASN:ND2	1.45	1.28
1:C:267:LEU:CD1	1:C:289:ALA:HB2	1.73	1.17
2:D:21:ILE:HB	2:D:57:ASP:O	1.47	1.14

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%)	276 (90%)	22 (7%)	10 (3%)	4 6
1	C	308/310 (99%)	283 (92%)	18 (6%)	7 (2%)	6 11
2	B	146/153 (95%)	104 (71%)	30 (20%)	12 (8%)	1 1
2	D	146/153 (95%)	102 (70%)	28 (19%)	16 (11%)	0 0
All	All	908/926 (98%)	765 (84%)	98 (11%)	45 (5%)	2 2

5 of 45 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	85	GLY
1	A	133	GLN
2	B	17	VAL
2	B	56	LYS
1	C	79	THR

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	261/261 (100%)	221 (85%)	40 (15%)	2	4
1	C	261/261 (100%)	214 (82%)	47 (18%)	1	2
2	B	132/137 (96%)	97 (74%)	35 (26%)	0	1
2	D	132/137 (96%)	84 (64%)	48 (36%)	0	0
All	All	786/796 (99%)	616 (78%)	170 (22%)	1	1

5 of 170 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	285	TYR
2	D	61	ILE
1	C	306	ARG
2	D	32	LEU
2	D	86	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 23 such sidechains are listed below:

Mol	Chain	Res	Type
2	D	40	GLN
2	D	73	GLN
2	D	63	ASN
2	D	80	GLN
1	A	297	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	$\#\|Z\| > 2$
3	MLI	A	311	-	6,6,6	1.95	2 (33%)	7,7,7	1.18	1 (14%)
3	MLI	C	312	-	6,6,6	2.27	2 (33%)	7,7,7	1.00	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
3	MLI	A	311	-	-	2/4/4/4	-
3	MLI	C	312	-	-	4/4/4/4	-

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	312	MLI	C1-C2	3.83	1.57	1.51
3	A	311	MLI	C1-C3	3.08	1.55	1.51
3	C	312	MLI	C1-C3	2.82	1.55	1.51
3	A	311	MLI	C1-C2	2.79	1.55	1.51

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	A	311	MLI	O7-C2-C1	2.02	120.98	114.54

There are no chirality outliers.

5 of 6 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	C	312	MLI	C3-C1-C2-O7
3	C	312	MLI	C3-C1-C2-O6
3	A	311	MLI	C2-C1-C3-O9
3	C	312	MLI	C2-C1-C3-O9
3	A	311	MLI	C2-C1-C3-O8

There are no ring outliers.

No monomer is involved in short contacts.

5.7 Other polymers (i)

There are no such residues in this entry.

5.8 Polymer linkage issues (i)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	A	3
2	D	2
1	C	1

The worst 5 of 6 chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	A	134:HIS	C	135:PRO	N	1.62
1	A	78:ASN	C	79:THR	N	1.19
1	A	83:LYS	C	84:LYS	N	1.19
1	D	14:ARG	C	15:GLY	N	1.19
1	D	28:LYS	C	29:LEU	N	1.19

6 Fit of model and data

6.1 Protein, DNA and RNA chains

Unable to reproduce the depositors R factor - this section is therefore empty.

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

Unable to reproduce the depositors R factor - this section is therefore empty.

6.3 Carbohydrates

Unable to reproduce the depositors R factor - this section is therefore empty.

6.4 Ligands

Unable to reproduce the depositors R factor - this section is therefore empty.

6.5 Other polymers

Unable to reproduce the depositors R factor - this section is therefore empty.