



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 11:18 PM UTC

PDB ID : 1PU2 / pdb_00001pu2
Title : Crystal Structure of the K246R Mutant of Aspartate Semialdehyde Dehydrogenase from Haemophilus influenzae
Authors : Blanco, J.; Moore, R.A.; Faehnle, C.R.; Coe, D.M.; Viola, R.E.
Deposited on : 2003-06-23
Resolution : 2.06 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 ⓘ 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

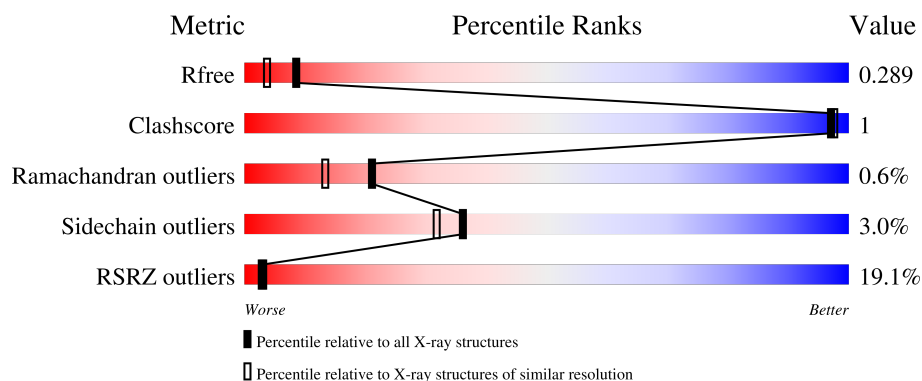
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.06 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}	180053	3774 (2.08-2.04)
Clashscore	190562	3883 (2.08-2.04)
Ramachandran outliers	187476	3860 (2.08-2.04)
Sidechain outliers	187428	3860 (2.08-2.04)
RSRZ outliers	180081	3775 (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 ≥ 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	371	18% 85% 11% .

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 2897 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-semialdehyde dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	357	Total	C	N	O	S	0	0	0
			2764	1762	466	521	15			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	136	HTI	CYS	modified residue	UNP P44801
A	246	ARG	LYS	engineered mutation	UNP P44801

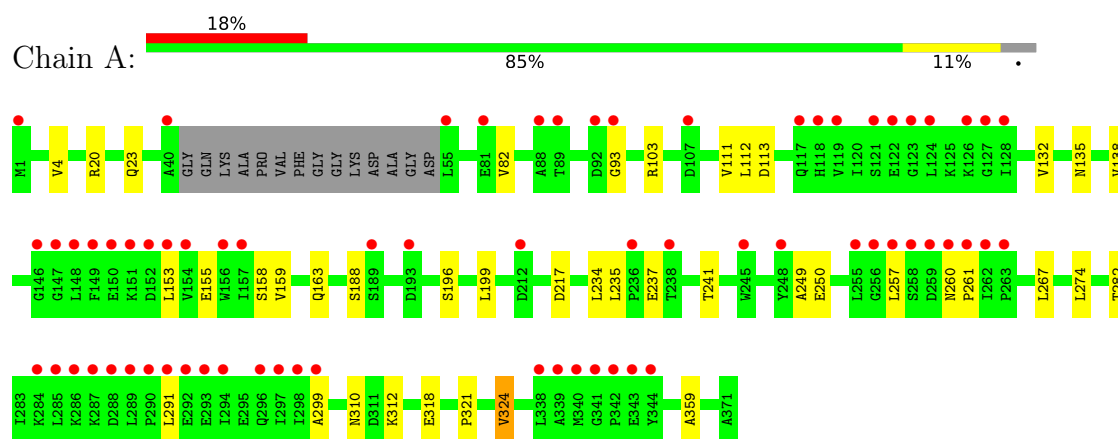
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	133	Total	O	0	0
			133	133		

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: Aspartate-semialdehyde dehydrogenase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	113.82Å 54.72Å 57.17Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	40.33 – 2.06 40.33 – 2.06	Depositor EDS
% Data completeness (in resolution range)	97.0 (40.33-2.06) 97.0 (40.33-2.06)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.06	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.88 (at 1.91Å)	Xtriage
Refinement program	CNS 1.0	Depositor
R, R_{free}	0.236 , 0.288 0.241 , 0.289	Depositor DCC
R_{free} test set	2177 reflections (7.85%)	wwPDB-VP
Wilson B-factor (Å ²)	22.3	Xtriage
Anisotropy	0.094	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 40.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.027 for -h,l,k	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	2897	wwPDB-VP
Average B, all atoms (Å ²)	29.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.25% 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

5.1 Standard geometry

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

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	0.70	0/2798	1.17	24/3783 (0.6%)

There are no bond length outliers.

All (24) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	359	ALA	N-CA-C	8.35	120.47	111.36
1	A	93	GLY	N-CA-C	7.07	123.51	111.98
1	A	188	SER	N-CA-C	6.66	118.20	111.07
1	A	113	ASP	N-CA-C	6.60	122.68	113.57
1	A	217	ASP	N-CA-C	6.48	118.88	111.11
1	A	318	GLU	N-CA-C	6.48	121.71	113.55
1	A	155	GLU	N-CA-C	-6.17	104.48	112.68
1	A	111	VAL	N-CA-C	6.14	118.21	108.87
1	A	82	VAL	N-CA-C	6.00	117.93	111.58
1	A	163	GLN	N-CA-C	5.97	119.99	109.96
1	A	250	GLU	N-CA-C	5.79	118.81	111.69
1	A	241	THR	N-CA-C	-5.74	102.03	110.52
1	A	299	ALA	N-CA-C	5.71	118.27	111.71
1	A	274	LEU	N-CA-C	5.67	118.55	111.24
1	A	312	LYS	N-CA-C	5.65	117.13	110.97
1	A	261	PRO	N-CA-C	5.61	119.67	111.03
1	A	324	VAL	N-CA-C	5.53	120.58	113.07
1	A	103	ARG	N-CA-C	5.51	118.00	111.33
1	A	235	LEU	CA-C-N	5.44	125.78	119.47
1	A	235	LEU	C-N-CA	5.44	125.78	119.47
1	A	196	SER	N-CA-C	5.40	117.69	110.35
1	A	249	ALA	N-CA-C	5.38	116.83	111.07
1	A	237	GLU	N-CA-C	5.25	117.08	111.36
1	A	4	VAL	N-CA-C	5.17	115.41	108.17

There are no chirality outliers.

There are no planarity outliers.

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	2764	0	2819	5	0
2	A	133	0	0	0	0
All	All	2897	0	2819	5	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 1.

All (5) 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:20:ARG:HH11	1:A:23:GLN:NE2	2.08	0.52
1:A:20:ARG:HH11	1:A:23:GLN:HE21	1.63	0.45
1:A:135:ASN:HD22	1:A:138:VAL:HG23	1.81	0.45
1:A:158:SER:HB3	1:A:282:THR:HB	2.00	0.43
1:A:257:LEU:HD22	1:A:260:ASN:HD21	1.83	0.43

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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	352/371 (95%)	335 (95%)	15 (4%)	2 (1%)	21	13

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	112	LEU
1	A	310	ASN

5.3.2 Protein sidechains ⓘ

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	296/304 (97%)	287 (97%)	9 (3%)	36	32

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	132	VAL
1	A	153	LEU
1	A	159	VAL
1	A	199	LEU
1	A	234	LEU
1	A	267	LEU
1	A	291	LEU
1	A	321	PRO
1	A	324	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	23	GLN
1	A	135	ASN
1	A	185	GLN
1	A	260	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

1 non-standard protein/DNA/RNA residue is 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	$\# Z > 2$
1	HTI	A	136	1	7,13,14	0.94	0	5,16,18	0.66	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
1	HTI	A	136	1	-	2/11/15/17	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	136	HTI	CAH-CAJ-CAK-NAL
1	A	136	HTI	CAH-CAJ-CAK-CAM

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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 ⓘ

6.1 Protein, DNA and RNA chains ⓘ

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	356/371 (95%)	0.98	68 (19%) 3 3	10, 26, 53, 66	0

All (68) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	260	ASN	5.2
1	A	261	PRO	5.1
1	A	297	ILE	4.9
1	A	290	PRO	4.8
1	A	40	ALA	4.6
1	A	121	SER	4.6
1	A	342	PRO	4.5
1	A	291	LEU	4.3
1	A	156	TRP	4.2
1	A	151	LYS	4.2
1	A	294	ILE	4.1
1	A	118	HIS	4.1
1	A	238	THR	4.1
1	A	262	ILE	4.0
1	A	285	LEU	3.8
1	A	255	LEU	3.7
1	A	338	LEU	3.7
1	A	287	LYS	3.6
1	A	293	GLU	3.6
1	A	341	GLY	3.6
1	A	245	TRP	3.5
1	A	259	ASP	3.4
1	A	153	LEU	3.3
1	A	340	MET	3.3
1	A	284	LYS	3.3
1	A	189	SER	3.1
1	A	119	VAL	3.1

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Mol	Chain	Res	Type	RSRZ
1	A	263	PRO	3.1
1	A	152	ASP	3.1
1	A	81	GLU	3.0
1	A	149	PHE	3.0
1	A	343	GLU	3.0
1	A	157	ILE	3.0
1	A	258	SER	2.9
1	A	124	LEU	2.9
1	A	123	GLY	2.9
1	A	92	ASP	2.9
1	A	339	ALA	2.9
1	A	248	TYR	2.9
1	A	148	LEU	2.8
1	A	55	LEU	2.8
1	A	126	LYS	2.8
1	A	296	GLN	2.8
1	A	289	LEU	2.7
1	A	88	ALA	2.7
1	A	1	MET	2.7
1	A	212	ASP	2.7
1	A	288	ASP	2.7
1	A	147	GLY	2.7
1	A	236	PRO	2.6
1	A	256	GLY	2.6
1	A	93	GLY	2.6
1	A	107	ASP	2.6
1	A	154	VAL	2.5
1	A	193	ASP	2.4
1	A	292	GLU	2.3
1	A	299	ALA	2.3
1	A	344	TYR	2.2
1	A	298	ILE	2.2
1	A	286	LYS	2.2
1	A	146	GLY	2.1
1	A	122	GLU	2.1
1	A	150	GLU	2.1
1	A	117	GLN	2.1
1	A	127	GLY	2.0
1	A	128	ILE	2.0
1	A	257	LEU	2.0
1	A	89	THR	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [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($\text{\AA}^2$)	Q<0.9
1	HTI	A	136	14/15	0.94	0.10	18,23,26,30	0

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.