



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 12, 2026 – 01:34 PM UTC

PDB ID : 1INO / pdb_00001ino
Title : RECOMBINANT INORGANIC PYROPHOSPHATASE FROM ES-
CHERICHIA COLI
Authors : Oganessian, V.Yu.; Avaeva, S.M.; Harutyunyan, E.H.
Deposited on : 1995-10-03
Resolution : 2.20 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
Xtriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

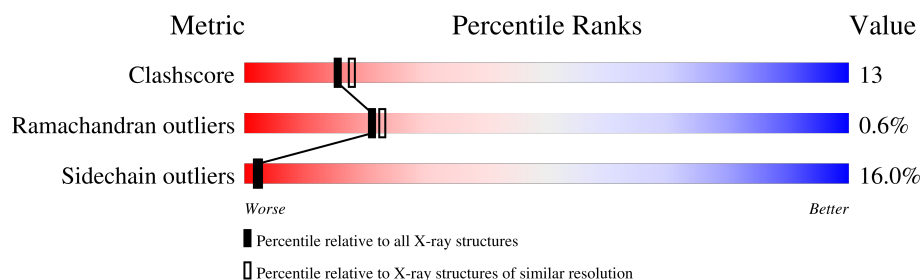
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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))
Clashscore	190562	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)

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 $\leq 5\%$

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	175	37% 47% 15%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 1527 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 INORGANIC PYROPHOSPHATASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	175	Total	C	N	O	S	0	0	0
			1381	889	224	263	5			

- Molecule 2 is MANGANESE (II) ION (CCD ID: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Mn	0	0
			1	1		

- Molecule 3 is water.

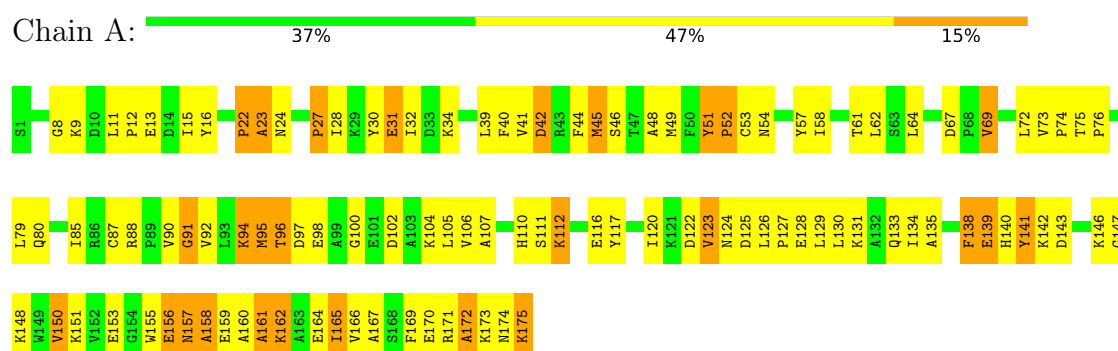
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	145	Total	O	0	0
			145	145		

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. 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.

Note EDS was not executed.

• Molecule 1: INORGANIC PYROPHOSPHATASE



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	H 3 2	Depositor
Cell constants a, b, c, α , β , γ	110.40 Å 110.40 Å 76.80 Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	12.00 – 2.20	Depositor
% Data completeness (in resolution range)	(Not available) (12.00-2.20)	Depositor
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	PROLSQ	Depositor
R, R_{free}	0.160 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	1527	wwPDB-VP
Average B, all atoms (Å ²)	20.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

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

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	1.04	1/1416 (0.1%)	2.41	106/1923 (5.5%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	80	GLN	C-N	5.15	1.39	1.33

All (106) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	24	ASN	OD1-CG-ND2	13.23	135.83	122.60
1	A	134	ILE	CA-C-N	11.65	135.59	120.44
1	A	134	ILE	C-N-CA	11.65	135.59	120.44
1	A	140	HIS	N-CA-C	10.05	126.77	113.30
1	A	158	ALA	CA-C-O	-9.55	110.68	120.90
1	A	157	ASN	N-CA-C	9.21	121.74	110.41
1	A	147	GLY	CA-C-O	9.10	128.79	118.96
1	A	102	ASP	CA-CB-CG	8.84	121.44	112.60
1	A	140	HIS	CA-CB-CG	-8.34	105.47	113.80
1	A	171	ARG	NE-CZ-NH2	8.32	126.69	119.20
1	A	134	ILE	O-C-N	-8.29	113.78	121.91
1	A	44	PHE	CA-C-O	-8.26	111.43	120.43
1	A	94	LYS	CA-C-O	8.08	129.90	120.69
1	A	156	GLU	O-C-N	-8.05	113.93	123.27
1	A	169	PHE	CA-CB-CG	-8.02	105.78	113.80
1	A	24	ASN	CA-CB-CG	-7.84	104.76	112.60
1	A	80	GLN	CA-C-N	-7.80	111.71	119.90
1	A	80	GLN	C-N-CA	-7.80	111.71	119.90
1	A	57	TYR	CA-C-O	-7.79	113.11	121.45
1	A	16	TYR	CA-C-O	-7.79	112.15	120.80

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	133	GLN	CA-C-N	7.76	130.34	120.56
1	A	133	GLN	C-N-CA	7.76	130.34	120.56
1	A	130	LEU	CA-C-O	-7.57	111.26	119.97
1	A	106	VAL	N-CA-CB	7.53	121.80	111.41
1	A	170	GLU	O-C-N	-7.48	114.19	122.12
1	A	24	ASN	N-CA-C	7.34	121.59	111.90
1	A	69	VAL	CA-C-N	7.29	132.15	122.30
1	A	69	VAL	C-N-CA	7.29	132.15	122.30
1	A	106	VAL	N-CA-C	-7.29	97.90	108.11
1	A	150	VAL	CB-CA-C	-7.17	99.54	111.29
1	A	160	ALA	N-CA-C	-7.07	103.65	111.36
1	A	123	VAL	CB-CA-C	-7.03	98.36	111.79
1	A	22	PRO	O-C-N	-7.01	114.44	123.00
1	A	138	PHE	CA-C-O	-7.01	113.12	120.55
1	A	91	GLY	CA-C-O	-6.94	114.82	121.41
1	A	140	HIS	CB-CA-C	-6.88	98.55	110.17
1	A	27	PRO	O-C-N	-6.87	113.37	122.64
1	A	170	GLU	CA-C-N	6.87	131.59	120.60
1	A	170	GLU	C-N-CA	6.87	131.59	120.60
1	A	139	GLU	CA-C-O	-6.86	112.08	119.97
1	A	123	VAL	N-CA-C	6.77	121.64	111.89
1	A	148	LYS	CB-CA-C	6.76	121.94	109.70
1	A	157	ASN	N-CA-CB	-6.63	101.29	110.38
1	A	61	THR	CA-C-O	6.60	128.72	121.06
1	A	133	GLN	N-CA-C	-6.58	104.03	111.14
1	A	142	LYS	CA-C-N	6.45	130.12	120.31
1	A	142	LYS	C-N-CA	6.45	130.12	120.31
1	A	74	PRO	CB-CA-C	6.32	119.62	111.21
1	A	24	ASN	CB-CG-ND2	-6.32	106.93	116.40
1	A	52	PRO	CA-C-N	6.17	132.21	122.21
1	A	52	PRO	C-N-CA	6.17	132.21	122.21
1	A	116	GLU	N-CA-C	6.17	118.98	111.82
1	A	171	ARG	CA-CB-CG	6.09	126.28	114.10
1	A	57	TYR	O-C-N	6.06	130.07	123.10
1	A	164	GLU	CA-C-O	-6.04	113.03	119.97
1	A	166	VAL	CB-CA-C	-6.02	104.18	111.88
1	A	134	ILE	CA-C-O	6.00	127.53	121.17
1	A	133	GLN	OE1-CD-NE2	-5.99	116.61	122.60
1	A	131	LYS	CA-C-N	5.94	129.34	120.31
1	A	131	LYS	C-N-CA	5.94	129.34	120.31
1	A	157	ASN	CA-CB-CG	5.92	118.52	112.60
1	A	51	TYR	CA-C-N	5.88	125.58	119.64

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	51	TYR	C-N-CA	5.88	125.58	119.64
1	A	143	ASP	CA-CB-CG	5.84	118.44	112.60
1	A	28	ILE	CA-C-O	-5.84	114.28	120.53
1	A	44	PHE	N-CA-C	-5.82	99.76	109.24
1	A	53	CYS	CA-C-N	5.82	128.97	120.71
1	A	53	CYS	C-N-CA	5.82	128.97	120.71
1	A	162	LYS	CA-C-N	5.80	130.54	120.68
1	A	162	LYS	C-N-CA	5.80	130.54	120.68
1	A	122	ASP	CA-C-O	-5.80	115.25	121.45
1	A	172	ALA	CA-C-O	5.79	126.38	119.60
1	A	167	ALA	O-C-N	-5.79	116.11	122.07
1	A	167	ALA	CA-C-N	5.78	128.50	120.29
1	A	167	ALA	C-N-CA	5.78	128.50	120.29
1	A	40	PHE	CA-CB-CG	5.77	119.57	113.80
1	A	138	PHE	CA-CB-CG	-5.75	108.05	113.80
1	A	97	ASP	CA-CB-CG	5.74	118.34	112.60
1	A	110	HIS	CA-C-N	5.72	128.52	120.28
1	A	110	HIS	C-N-CA	5.72	128.52	120.28
1	A	95	MET	O-C-N	5.66	129.82	123.48
1	A	165	ILE	N-CA-C	-5.63	105.13	110.42
1	A	96	THR	CA-C-O	-5.58	114.18	120.32
1	A	48	ALA	O-C-N	-5.53	115.05	122.68
1	A	116	GLU	N-CA-CB	-5.50	101.75	110.28
1	A	124	ASN	N-CA-C	-5.50	106.07	112.89
1	A	24	ASN	N-CA-CB	-5.49	103.79	112.08
1	A	67	ASP	N-CA-CB	-5.49	102.09	109.88
1	A	171	ARG	NH1-CZ-NH2	-5.46	112.20	119.30
1	A	112	LYS	CA-C-O	-5.46	112.67	119.38
1	A	88	ARG	CG-CD-NE	5.43	123.95	112.00
1	A	141	TYR	CA-C-O	-5.40	114.00	120.10
1	A	128	GLU	CA-CB-CG	5.39	124.87	114.10
1	A	148	LYS	N-CA-CB	-5.36	101.53	110.80
1	A	45	MET	CA-C-O	-5.32	115.20	121.16
1	A	88	ARG	CA-C-N	5.30	125.22	119.76
1	A	88	ARG	C-N-CA	5.30	125.22	119.76
1	A	49	MET	CA-CB-CG	5.28	124.66	114.10
1	A	23	ALA	O-C-N	-5.23	116.69	122.86
1	A	128	GLU	CB-CG-CD	5.17	121.39	112.60
1	A	41	VAL	N-CA-C	-5.10	102.27	109.21
1	A	90	VAL	N-CA-C	-5.04	108.92	113.71
1	A	61	THR	N-CA-CB	5.03	120.89	111.53
1	A	147	GLY	O-C-N	-5.02	116.93	122.50

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	127	PRO	O-C-N	-5.01	116.62	122.99
1	A	161	ALA	CB-CA-C	-5.01	102.99	110.90

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	1381	0	1369	37	0
2	A	1	0	0	0	0
3	A	145	0	0	2	0
All	All	1527	0	1369	37	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 13.

All (37) 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:73:VAL:HG11	1:A:85:ILE:HD13	1.68	0.76
1:A:92:VAL:HG13	1:A:156:GLU:HB2	1.65	0.75
1:A:22:PRO:HA	1:A:54:ASN:HD22	1.54	0.73
1:A:27:PRO:HB3	1:A:45:MET:HE2	1.72	0.70
1:A:72:LEU:HD11	1:A:138:PHE:HE2	1.56	0.69
1:A:62:LEU:HD12	1:A:172:ALA:HA	1.76	0.68
1:A:79:LEU:HD11	1:A:85:ILE:HD12	1.76	0.67
1:A:8:GLY:HA3	1:A:15:ILE:HA	1.80	0.63
1:A:72:LEU:HD11	1:A:138:PHE:CE2	2.35	0.62
1:A:75:THR:HB	1:A:76:PRO:HD2	1.83	0.61
1:A:175:LYS:NZ	1:A:175:LYS:HB2	2.15	0.61
1:A:105:LEU:HD13	1:A:161:ALA:HB1	1.88	0.55
1:A:15:ILE:HD12	1:A:58:ILE:HD11	1.89	0.53
1:A:135:ALA:O	1:A:139:GLU:HG3	2.09	0.53
1:A:75:THR:HB	1:A:76:PRO:CD	2.39	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:95:MET:HE1	1:A:138:PHE:HB3	1.91	0.52
1:A:91:GLY:HA3	1:A:123:VAL:HG13	1.91	0.52
1:A:45:MET:HG2	3:A:188:HOH:O	2.11	0.50
1:A:11:LEU:HD23	1:A:15:ILE:HG22	1.96	0.48
1:A:158:ALA:O	1:A:162:LYS:HG3	2.14	0.48
1:A:155:TRP:HB2	3:A:309:HOH:O	2.14	0.47
1:A:117:TYR:HD2	1:A:120:ILE:HD12	1.81	0.46
1:A:92:VAL:CG1	1:A:156:GLU:HB2	2.40	0.44
1:A:15:ILE:HD12	1:A:58:ILE:CD1	2.48	0.44
1:A:30:TYR:CD1	1:A:39:LEU:HD21	2.53	0.44
1:A:92:VAL:HB	1:A:105:LEU:HD22	2.00	0.44
1:A:23:ALA:H	1:A:54:ASN:ND2	2.15	0.44
1:A:120:ILE:HA	1:A:125:ASP:HB3	2.00	0.43
1:A:94:LYS:CG	1:A:156:GLU:HG3	2.48	0.43
1:A:22:PRO:HA	1:A:54:ASN:ND2	2.28	0.43
1:A:87:CYS:HB3	1:A:107:ALA:HB1	2.00	0.43
1:A:31:GLU:HB3	1:A:42:ASP:OD2	2.20	0.41
1:A:162:LYS:HA	1:A:165:ILE:HD12	2.00	0.41
1:A:96:THR:HA	1:A:100:GLY:O	2.19	0.41
1:A:51:TYR:HA	1:A:52:PRO:HD3	1.90	0.41
1:A:34:LYS:HD2	1:A:34:LYS:N	2.36	0.41
1:A:94:LYS:HG3	1:A:156:GLU:HG3	2.02	0.40

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	173/175 (99%)	161 (93%)	11 (6%)	1 (1%)	21 23

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	153	GLU

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	150/150 (100%)	126 (84%)	24 (16%)	2 2

All (24) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	9	LYS
1	A	12	PRO
1	A	13	GLU
1	A	31	GLU
1	A	32	ILE
1	A	42	ASP
1	A	46	SER
1	A	64	LEU
1	A	69	VAL
1	A	98	GLU
1	A	104	LYS
1	A	111	SER
1	A	112	LYS
1	A	126	LEU
1	A	129	LEU
1	A	141	TYR
1	A	146	LYS
1	A	150	VAL
1	A	151	LYS
1	A	157	ASN
1	A	159	GLU
1	A	173	LYS
1	A	174	ASN
1	A	175	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such

sidechains are listed below:

Mol	Chain	Res	Type
1	A	4	ASN
1	A	54	ASN
1	A	80	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 1 ligands modelled in this entry, 1 is monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

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](#)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.