



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 30, 2026 – 10:10 AM UTC

PDB ID : 2Y40 / pdb_00002y40
Title : Structure of Isopropylmalate dehydrogenase from *Thermus thermophilus* - complex with Mn
Authors : Graczer, E.; merlin, A.; Singh, R.K.; Manikandan, K.; Zavodsky, P.; Weiss, M.S.; Vas, M.
Deposited on : 2011-01-04
Resolution : 2.50 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
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

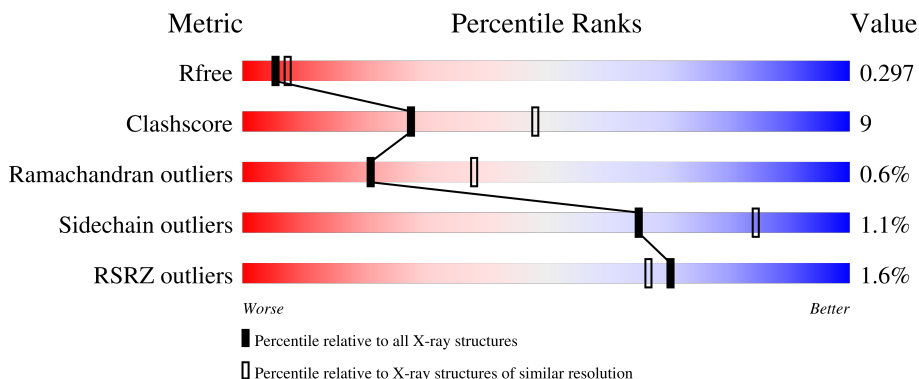
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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	5829 (2.50-2.50)
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)
RSRZ outliers	180081	5833 (2.50-2.50)

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	359	% 75% 20% ..
1	B	359	2% 72% 22% ..

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5273 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 3-ISOPROPYLMALATE DEHYDROGENASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	347	Total	C	N	O	S	0	0	0
			2604	1660	454	484	6			
1	B	346	Total	C	N	O	S	0	0	1
			2595	1654	453	482	6			

There are 28 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	MET	-	expression tag	UNP Q5SIY4
A	-1	ALA	-	expression tag	UNP Q5SIY4
A	0	SER	-	expression tag	UNP Q5SIY4
A	346	ALA	-	expression tag	UNP Q5SIY4
A	347	ALA	-	expression tag	UNP Q5SIY4
A	348	ALA	-	expression tag	UNP Q5SIY4
A	349	LEU	-	expression tag	UNP Q5SIY4
A	350	GLU	-	expression tag	UNP Q5SIY4
A	351	HIS	-	expression tag	UNP Q5SIY4
A	352	HIS	-	expression tag	UNP Q5SIY4
A	353	HIS	-	expression tag	UNP Q5SIY4
A	354	HIS	-	expression tag	UNP Q5SIY4
A	355	HIS	-	expression tag	UNP Q5SIY4
A	356	HIS	-	expression tag	UNP Q5SIY4
B	-2	MET	-	expression tag	UNP Q5SIY4
B	-1	ALA	-	expression tag	UNP Q5SIY4
B	0	SER	-	expression tag	UNP Q5SIY4
B	346	ALA	-	expression tag	UNP Q5SIY4
B	347	ALA	-	expression tag	UNP Q5SIY4
B	348	ALA	-	expression tag	UNP Q5SIY4
B	349	LEU	-	expression tag	UNP Q5SIY4
B	350	GLU	-	expression tag	UNP Q5SIY4
B	351	HIS	-	expression tag	UNP Q5SIY4
B	352	HIS	-	expression tag	UNP Q5SIY4
B	353	HIS	-	expression tag	UNP Q5SIY4

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Chain	Residue	Modelled	Actual	Comment	Reference
B	354	HIS	-	expression tag	UNP Q5SIY4
B	355	HIS	-	expression tag	UNP Q5SIY4
B	356	HIS	-	expression tag	UNP Q5SIY4

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

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

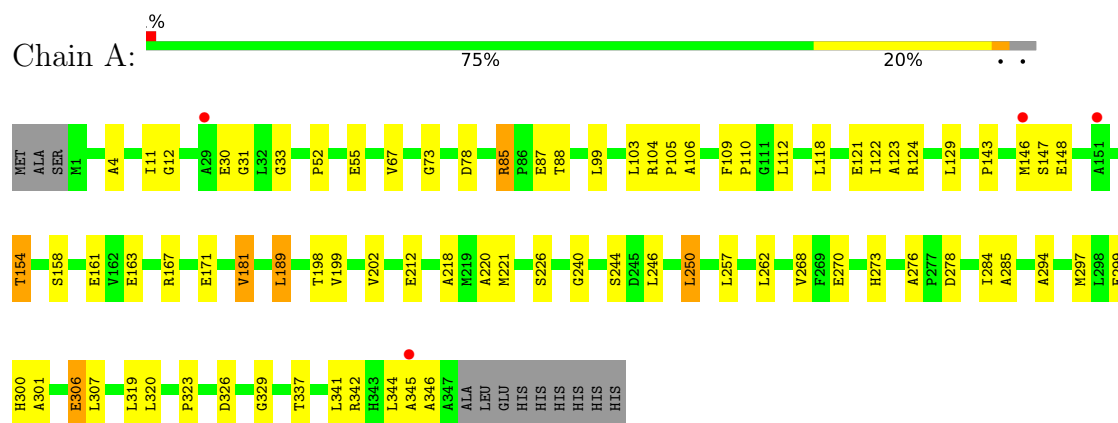
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	45	Total 45	O 45	0	0
3	B	26	Total 26	O 26	0	0

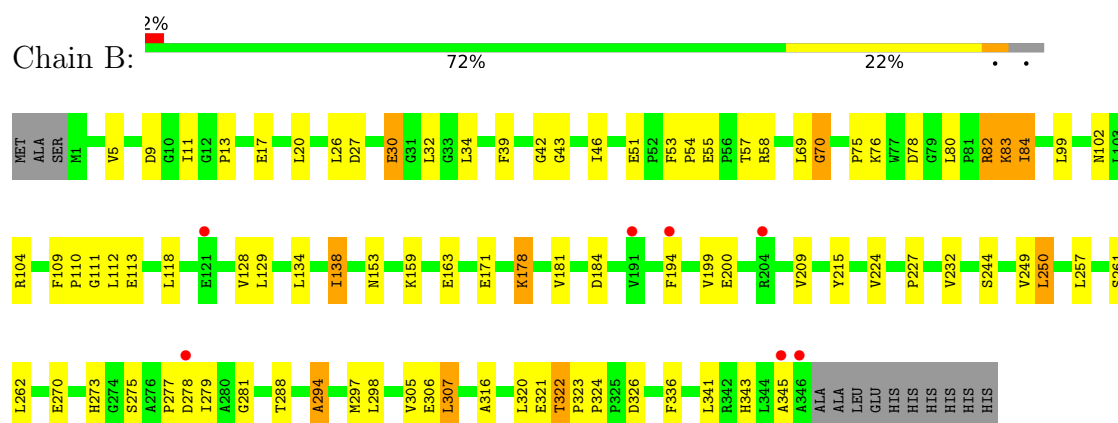
3 Residue-property plots

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: 3-ISOPROPYLMALATE DEHYDROGENASE



• Molecule 1: 3-ISOPROPYLMALATE DEHYDROGENASE



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	85.49Å 112.01Å 82.26Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	28.12 – 2.50 28.12 – 2.50	Depositor EDS
% Data completeness (in resolution range)	98.2 (28.12-2.50) 98.1 (28.12-2.50)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.31 (at 2.51Å)	Xtriage
Refinement program	REFMAC 5.5.0088	Depositor
R, R_{free}	0.225 , 0.298 0.232 , 0.297	Depositor DCC
R_{free} test set	982 reflections (3.57%)	wwPDB-VP
Wilson B-factor (Å ²)	51.5	Xtriage
Anisotropy	0.118	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.27 , 37.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.004 for l,-k,h	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	5273	wwPDB-VP
Average B, all atoms (Å ²)	63.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.07% 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: 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	1.19	6/2659 (0.2%)	1.41	24/3610 (0.7%)
1	B	1.07	1/2650 (0.0%)	1.33	23/3598 (0.6%)
All	All	1.13	7/5309 (0.1%)	1.37	47/7208 (0.7%)

The worst 5 of 7 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	294	ALA	CA-CB	-7.04	1.42	1.53
1	A	220	ALA	CA-CB	-6.55	1.43	1.53
1	B	345	ALA	C-N	-5.86	1.25	1.33
1	A	85	ARG	CA-C	5.85	1.60	1.53
1	A	106	ALA	CA-CB	-5.41	1.45	1.52

The worst 5 of 47 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	250	LEU	CA-C-N	-10.71	108.47	120.04
1	B	250	LEU	C-N-CA	-10.71	108.47	120.04
1	A	250	LEU	CA-C-N	-9.65	109.89	119.64
1	A	250	LEU	C-N-CA	-9.65	109.89	119.64
1	A	270	GLU	N-CA-C	8.13	115.54	108.22

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	2604	0	2643	37	0
1	B	2595	0	2633	62	0
2	A	1	0	0	0	0
2	B	2	0	0	0	0
3	A	45	0	0	3	0
3	B	26	0	0	3	0
All	All	5273	0	5276	94	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 9.

The worst 5 of 94 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:300:HIS:N	3:A:2040:HOH:O	1.98	0.96
1:B:82:ARG:HG3	1:B:83:LYS:H	1.32	0.94
1:B:109:PHE:HB2	1:B:112:LEU:HD12	1.51	0.92
1:B:13:PRO:O	1:B:17:GLU:HG3	1.77	0.83
1:B:53:PHE:CE2	1:B:58:ARG:HG2	2.23	0.74

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	345/359 (96%)	326 (94%)	17 (5%)	2 (1%)	21	38
1	B	344/359 (96%)	314 (91%)	28 (8%)	2 (1%)	21	38
All	All	689/718 (96%)	640 (93%)	45 (6%)	4 (1%)	21	38

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	82	ARG
1	B	83	LYS
1	A	31	GLY
1	A	346	ALA

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	266/276 (96%)	265 (100%)	1 (0%)	84	93
1	B	266/276 (96%)	261 (98%)	5 (2%)	50	76
All	All	532/552 (96%)	526 (99%)	6 (1%)	65	84

5 of 6 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	262	LEU
1	B	307	LEU
1	B	326	ASP
1	B	128	VAL
1	A	306	GLU

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	102	ASN
1	B	102	ASN
1	B	214	GLN
1	B	343	HIS

5.3.3 RNA ⓘ

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 3 ligands modelled in this entry, 3 are 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 [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	347/359 (96%)	0.14	4 (1%) 76 73	34, 57, 82, 123	0
1	B	346/359 (96%)	0.40	7 (2%) 65 61	40, 68, 98, 121	0
All	All	693/718 (96%)	0.27	11 (1%) 70 67	34, 62, 93, 123	0

The worst 5 of 11 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	346	ALA	4.5
1	B	345	ALA	3.1
1	A	345	ALA	2.6
1	A	151	ALA	2.6
1	B	194	PHE	2.6

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($\text{\AA}^2$)	Q<0.9
2	MN	B	401	1/1	0.94	0.09	49,49,49,49	0
2	MN	B	402	1/1	0.97	0.05	87,87,87,87	0
2	MN	A	401	1/1	0.98	0.06	51,51,51,51	0

6.5 Other polymers [i](#)

There are no such residues in this entry.