



# Full wwPDB X-ray Structure Validation Report ⓘ

May 13, 2020 – 05:05 am BST

PDB ID : 1TUO  
Title : Crystal structure of putative phosphomannomutase from *Thermus Thermophilus* HB8  
Authors : Misaki, S.; Suzuki, S.; Fujimoto, S.; Sakurai, M.; Kobayashi, M.; Nishijima, K.; Kunishima, N.; Sugawara, M.; Kuroishi, C.; RIKEN Structural Genomics/Proteomics Initiative (RSGI)  
Deposited on : 2004-06-25  
Resolution : 1.70 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](mailto: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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Xtriage (Phenix) : 1.13  
EDS : 2.11  
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) : 2.11

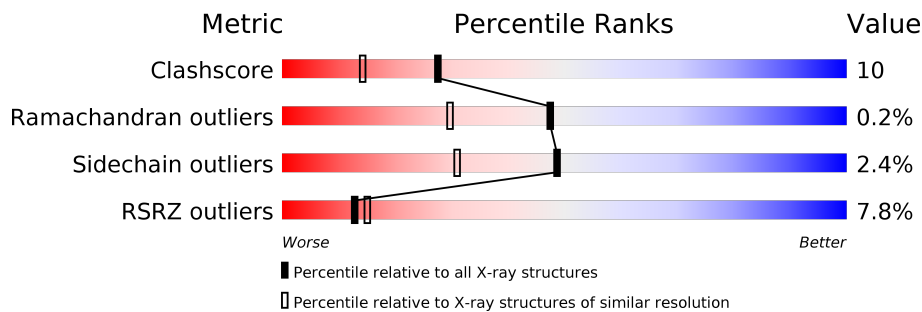
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.70 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	141614	4695 (1.70-1.70)
Ramachandran outliers	138981	4610 (1.70-1.70)
Sidechain outliers	138945	4610 (1.70-1.70)
RSRZ outliers	127900	4222 (1.70-1.70)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 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	464	

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3626 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 Putative phosphomannomutase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	437	3346	2156	585	600	5	0	0	0

There are 7 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	CLONING ARTIFACT	UNP Q5SKJ3
A	2	CYS	-	CLONING ARTIFACT	UNP Q5SKJ3
A	3	TYR	-	CLONING ARTIFACT	UNP Q5SKJ3
A	4	ALA	-	CLONING ARTIFACT	UNP Q5SKJ3
A	5	SER	-	CLONING ARTIFACT	UNP Q5SKJ3
A	6	MET	-	CLONING ARTIFACT	UNP Q5SKJ3
A	7	GLU	-	CLONING ARTIFACT	UNP Q5SKJ3

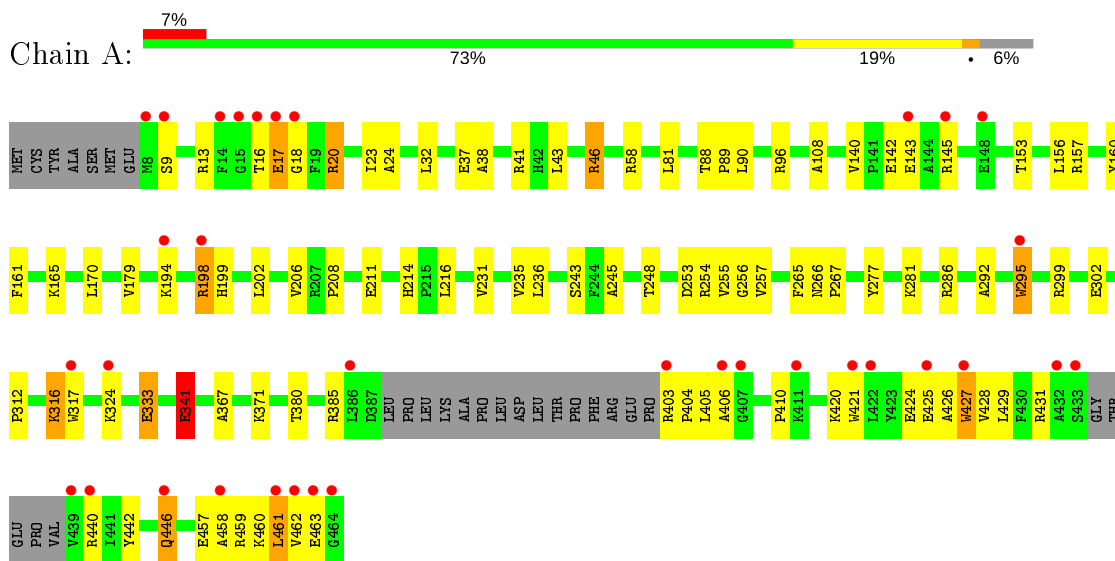
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	280	Total	O	0	0
			280	280		

### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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: Putative phosphomannomutase



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	106.61Å 55.05Å 83.76Å 90.00° 108.76° 90.00°	Depositor
Resolution (Å)	30.00 – 1.70 37.61 – 1.70	Depositor EDS
% Data completeness (in resolution range)	99.0 (30.00-1.70) 95.2 (37.61-1.70)	Depositor EDS
$R_{merge}$	0.04	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.22 (at 1.70Å)	Xtrriage
Refinement program	CNX	Depositor
R, $R_{free}$	0.221 , 0.247 0.213 , (Not available)	Depositor DCC
$R_{free}$ test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	23.6	Xtrriage
Anisotropy	0.088	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 44.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	3626	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	28.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.65% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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

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	0.34	0/3426	1.21	17/4642 (0.4%)

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

There are no bond length outliers.

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	96	ARG	NE-CZ-NH2	-29.04	105.78	120.30
1	A	145	ARG	NE-CZ-NH1	-28.88	105.86	120.30
1	A	145	ARG	NE-CZ-NH2	26.57	133.59	120.30
1	A	46	ARG	NE-CZ-NH1	-25.18	107.71	120.30
1	A	96	ARG	NE-CZ-NH1	23.54	132.07	120.30
1	A	46	ARG	NE-CZ-NH2	19.73	130.17	120.30
1	A	46	ARG	CD-NE-CZ	-15.51	101.89	123.60
1	A	96	ARG	CD-NE-CZ	-14.62	103.14	123.60
1	A	20	ARG	NE-CZ-NH2	-13.82	113.39	120.30
1	A	20	ARG	NE-CZ-NH1	9.07	124.83	120.30
1	A	316	LYS	CD-CE-NZ	-7.65	94.11	111.70
1	A	341	GLU	CG-CD-OE1	-7.55	103.19	118.30
1	A	143	GLU	CB-CG-CD	-7.24	94.65	114.20
1	A	341	GLU	CG-CD-OE2	7.24	132.78	118.30
1	A	143	GLU	CG-CD-OE2	-6.31	105.68	118.30
1	A	143	GLU	CG-CD-OE1	5.79	129.88	118.30
1	A	43	LEU	CB-CG-CD2	5.09	119.65	111.00

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	20	ARG	Sidechain
1	A	46	ARG	Sidechain

## 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	3346	0	3371	67	0
2	A	280	0	0	8	0
All	All	3626	0	3371	67	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 10.

All (67) 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:211:GLU:HG2	2:A:1249:HOH:O	1.67	0.94
1:A:292:ALA:HB3	1:A:333:GLU:HG2	1.58	0.84
1:A:403:ARG:HH11	1:A:461:LEU:HG	1.49	0.75
1:A:165:LYS:HG3	1:A:170:LEU:HD11	1.69	0.73
1:A:198:ARG:HH21	1:A:199:HIS:HB2	1.61	0.64
1:A:292:ALA:CB	1:A:333:GLU:HG2	2.30	0.62
1:A:427:TRP:HE1	1:A:429:LEU:HB2	1.64	0.62
1:A:157:ARG:HG2	1:A:161:PHE:CE2	2.36	0.60
1:A:179:VAL:HG12	1:A:243:SER:OG	2.02	0.59
1:A:367:ALA:O	1:A:371:LYS:HG2	2.02	0.59
1:A:292:ALA:HB3	1:A:333:GLU:CG	2.32	0.58
1:A:257:VAL:HB	1:A:265:PHE:HB3	1.86	0.57
1:A:295:TRP:HH2	1:A:426:ALA:N	2.02	0.57
1:A:18:GLY:N	2:A:1132:HOH:O	2.37	0.57
1:A:316:LYS:NZ	2:A:1229:HOH:O	2.38	0.56
1:A:341:GLU:HG2	2:A:1263:HOH:O	2.06	0.56
1:A:194:LYS:NZ	1:A:208:PRO:HD3	2.21	0.56
1:A:37:GLU:O	1:A:41:ARG:HG3	2.05	0.55

*Continued on next page...*

*Continued from previous page...*

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:214:HIS:CE1	1:A:216:LEU:HB2	2.41	0.55
1:A:385:ARG:HD2	1:A:440:ARG:HH21	1.71	0.55
1:A:286:ARG:NH2	1:A:324:LYS:HD2	2.22	0.54
1:A:194:LYS:HZ1	1:A:208:PRO:HD3	1.71	0.54
1:A:427:TRP:CD1	1:A:427:TRP:C	2.80	0.54
1:A:253:ASP:OD2	1:A:254:ARG:HG3	2.08	0.53
1:A:194:LYS:HG2	1:A:206:VAL:HB	1.91	0.53
1:A:380:THR:HB	1:A:446:GLN:HG3	1.92	0.52
1:A:295:TRP:CH2	1:A:426:ALA:N	2.79	0.51
1:A:312:PRO:HD2	1:A:317:TRP:CD2	2.46	0.50
1:A:88:THR:N	1:A:89:PRO:HD2	2.27	0.49
1:A:13:ARG:HG2	1:A:13:ARG:HH21	1.78	0.49
1:A:156:LEU:HD23	2:A:1246:HOH:O	2.12	0.48
1:A:299:ARG:O	1:A:302:GLU:HG2	2.14	0.48
1:A:58:ARG:CZ	1:A:108:ALA:HB3	2.44	0.48
1:A:248:THR:HG22	1:A:255:VAL:HG12	1.95	0.47
1:A:266:ASN:HB2	1:A:267:PRO:HD2	1.97	0.47
1:A:420:LYS:HG3	1:A:427:TRP:CD1	2.49	0.47
1:A:16:THR:O	1:A:17:GLU:HB2	2.14	0.47
1:A:385:ARG:CD	1:A:440:ARG:HH21	2.27	0.47
1:A:194:LYS:HE2	1:A:206:VAL:O	2.15	0.46
1:A:254:ARG:NH2	2:A:1223:HOH:O	2.48	0.46
1:A:9:SER:HB3	1:A:142:GLU:OE1	2.15	0.46
1:A:90:LEU:HD13	1:A:160:TYR:HB2	1.98	0.45
1:A:266:ASN:HB2	1:A:267:PRO:CD	2.46	0.45
1:A:236:LEU:HD21	1:A:245:ALA:HB2	1.99	0.45
1:A:81:LEU:O	1:A:153:THR:HA	2.17	0.44
1:A:404:PRO:HB3	1:A:410:PRO:HD3	1.99	0.44
1:A:459:ARG:O	1:A:462:VAL:HG22	2.17	0.44
1:A:403:ARG:HB2	1:A:421:TRP:CH2	2.53	0.43
1:A:424:GLU:O	1:A:425:GLU:HB2	2.19	0.43
1:A:405:LEU:HD13	1:A:458:ALA:HB2	2.00	0.43
1:A:403:ARG:NH1	1:A:461:LEU:HG	2.27	0.43
1:A:231:VAL:O	1:A:235:VAL:HG23	2.19	0.43
1:A:427:TRP:HE1	1:A:429:LEU:CB	2.28	0.43
1:A:427:TRP:CD1	1:A:428:VAL:N	2.88	0.42
1:A:431:ARG:HG2	1:A:431:ARG:HH11	1.84	0.42
1:A:431:ARG:HD3	1:A:442:TYR:CE1	2.54	0.41
1:A:38:ALA:HB2	1:A:140:VAL:HA	2.02	0.41
1:A:23:ILE:O	1:A:24:ALA:HB3	2.20	0.41
1:A:202:LEU:HD23	1:A:202:LEU:HA	1.93	0.41

*Continued on next page...*



Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:17:GLU:N	1:A:17:GLU:OE1	2.53	0.41
1:A:256:GLY:HA2	2:A:1105:HOH:O	2.20	0.41
1:A:421:TRP:CH2	1:A:461:LEU:HD23	2.55	0.41
1:A:32:LEU:HD13	1:A:32:LEU:C	2.41	0.41
1:A:405:LEU:O	1:A:406:ALA:HB3	2.21	0.41
1:A:41:ARG:NH1	2:A:1131:HOH:O	2.54	0.40
1:A:277:TYR:CZ	1:A:281:LYS:HD2	2.56	0.40
1:A:457:GLU:OE2	1:A:460:LYS:HE2	2.22	0.40

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	431/464 (93%)	416 (96%)	14 (3%)	1 (0%)	47 30

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	463	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	338/362 (93%)	330 (98%)	8 (2%)	49 31

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	17	GLU
1	A	198	ARG
1	A	295	TRP
1	A	333	GLU
1	A	341	GLU
1	A	427	TRP
1	A	446	GLN
1	A	461	LEU

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

Mol	Chain	Res	Type
1	A	110	HIS
1	A	111	ASN
1	A	130	GLN
1	A	221	ASN

### 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 carbohydrates 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	437/464 (94%)	0.32	34 (7%) <b>13</b> <b>15</b>	15, 24, 47, 62	0

All (34) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	464	GLY	13.6
1	A	8	MET	9.6
1	A	432	ALA	5.6
1	A	439	VAL	5.5
1	A	463	GLU	5.3
1	A	16	THR	5.0
1	A	458	ALA	4.9
1	A	427	TRP	4.8
1	A	461	LEU	4.7
1	A	9	SER	4.6
1	A	145	ARG	4.5
1	A	425	GLU	4.1
1	A	433	SER	4.1
1	A	462	VAL	4.0
1	A	411	LYS	3.6
1	A	406	ALA	3.5
1	A	403	ARG	3.2
1	A	15	GLY	3.2
1	A	17	GLU	3.0
1	A	422	LEU	3.0
1	A	295	TRP	2.9
1	A	18	GLY	2.6
1	A	386	LEU	2.5
1	A	421	TRP	2.4
1	A	198	ARG	2.3
1	A	194	LYS	2.3
1	A	14	PHE	2.3

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type	RSRZ
1	A	440	ARG	2.3
1	A	143	GLU	2.2
1	A	446	GLN	2.2
1	A	324	LYS	2.2
1	A	317	TRP	2.1
1	A	148	GLU	2.1
1	A	407	GLY	2.0

## 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 carbohydrates 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.