



# Full wwPDB X-ray Structure Validation Report ⓘ

May 16, 2020 – 02:27 pm BST

PDB ID : 4D1B  
Title : STRUCTURE OF MHP1, A NUCLEOBASE-CATION-SYMPORT-1 FAMILY TRANSPORTER, IN A CLOSED CONFORMATION WITH BENZYL-HYDANTOIN  
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Deposited on : 2014-05-01  
Resolution : 3.80 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.

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The following versions of software and data (see [references ⓘ](#)) 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 : 2.11  
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

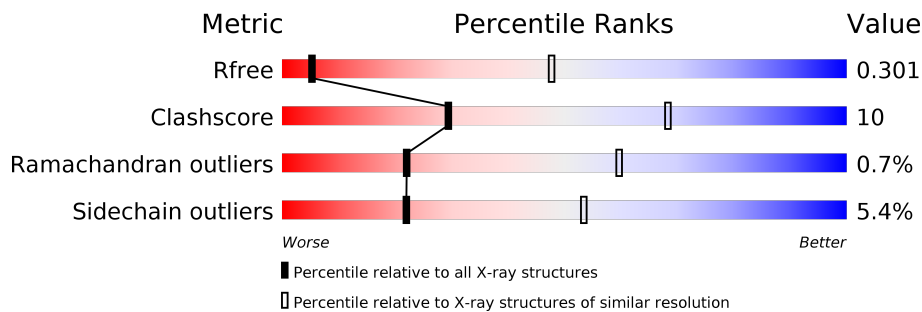
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*


The reported resolution of this entry is 3.80 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	1212 (4.00-3.60)
Clashscore	141614	1288 (4.00-3.60)
Ramachandran outliers	138981	1243 (4.00-3.60)
Sidechain outliers	138945	1237 (4.00-3.60)

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 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  $\leq 5\%$ .

Mol	Chain	Length	Quality of chain
1	A	495	 67% 24% 8%

## 2 Entry composition i

There are 3 unique types of molecules in this entry. The entry contains 3528 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.

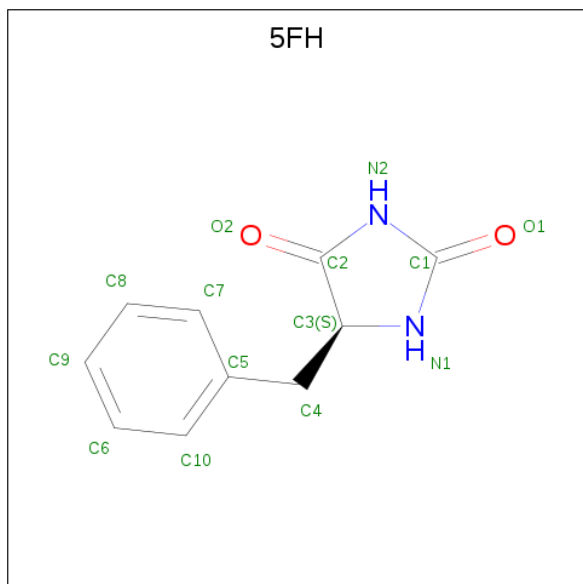
- Molecule 1 is a protein called HYDANTOIN TRANSPORT PROTEIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	456	3513	2336	563	592	22	0	0	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	488	GLY	-	expression tag	UNP D6R8X8
A	489	SER	-	expression tag	UNP D6R8X8
A	490	GLU	-	expression tag	UNP D6R8X8
A	491	ASN	-	expression tag	UNP D6R8X8
A	492	LEU	-	expression tag	UNP D6R8X8
A	493	TYR	-	expression tag	UNP D6R8X8
A	494	PHE	-	expression tag	UNP D6R8X8
A	495	GLN	-	expression tag	UNP D6R8X8

- Molecule 2 is (5S)-5-benzylimidazolidine-2,4-dione (three-letter code: 5FH) (formula:  $C_{10}H_{10}N_2O_2$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	14	10	2	2	0	0

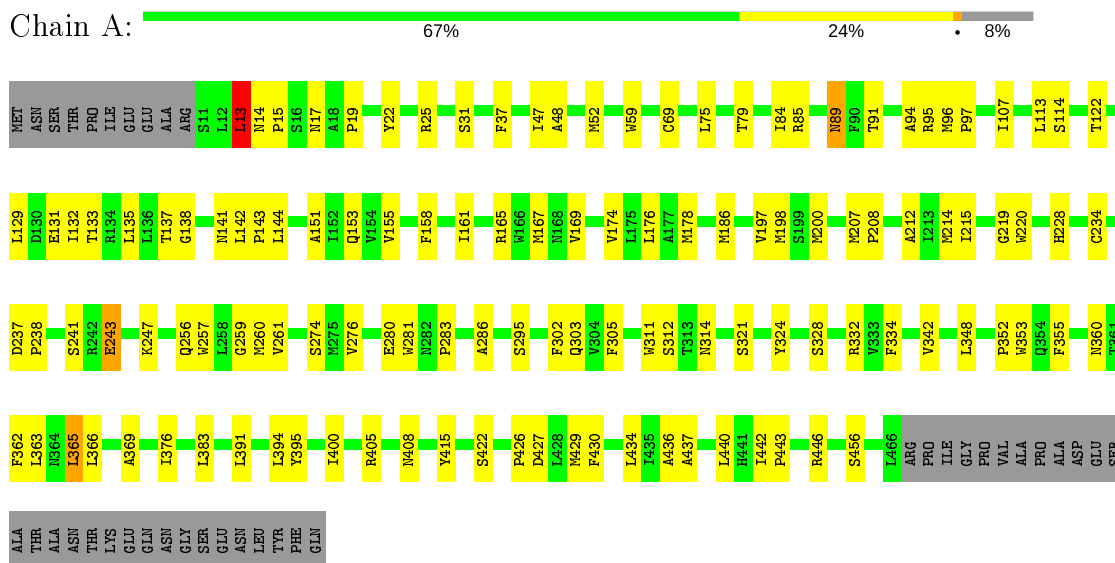
- Molecule 3 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Na		
3	A	1	1	1	0	0

### 3 Residue-property plots

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. 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: HYDANTOIN TRANSPORT PROTEIN



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	95.61Å 106.74Å 107.85Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	43.71 – 3.80 47.83 – 3.60	Depositor EDS
% Data completeness (in resolution range)	92.3 (43.71-3.80) 93.5 (47.83-3.60)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.27 (at 3.57Å)	Xtrriage
Refinement program	PHENIX (PHENIX.REFINE)	Depositor
R, $R_{free}$	0.283 , 0.308 0.297 , 0.301	Depositor DCC
$R_{free}$ test set	1284 reflections (10.33%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	130.8	Xtrriage
Anisotropy	0.681	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.25 , 136.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.37$ , $\langle L^2 \rangle = 0.20$	Xtrriage
Estimated twinning fraction	0.043 for -h,l,k	Xtrriage
$F_o, F_c$ correlation	0.88	EDS
Total number of atoms	3528	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	218.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.83% 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](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 5FH, NA

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	0.26	0/3610	0.53	1/4936 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	13	LEU	CA-CB-CG	5.29	127.47	115.30

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	3513	0	3604	68	0
2	A	14	0	10	1	0
3	A	1	0	0	0	0
All	All	3528	0	3614	68	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 (68) 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:283:PRO:HG2	1:A:302:PHE:HZ	1.43	0.83
1:A:59:TRP:HB3	1:A:198:MET:HG3	1.62	0.82
1:A:219:GLY:HA2	1:A:363:LEU:HD22	1.72	0.69
1:A:283:PRO:HG2	1:A:302:PHE:CZ	2.28	0.68
1:A:75:LEU:HD11	1:A:430:PHE:HZ	1.63	0.63
1:A:153:GLN:OE1	1:A:314:ASN:ND2	2.30	0.63
1:A:37:PHE:HZ	1:A:176:LEU:HD13	1.65	0.62
1:A:436:ALA:O	1:A:440:LEU:HG	1.98	0.62
1:A:75:LEU:HD21	1:A:434:LEU:HD11	1.83	0.61
1:A:369:ALA:O	1:A:415:TYR:OH	2.19	0.60
1:A:426:PRO:HA	1:A:429:MET:HG3	1.84	0.60
1:A:13:LEU:HD12	1:A:14:ASN:N	2.20	0.57
1:A:25:ARG:NH1	1:A:84:ILE:O	2.35	0.57
1:A:442:ILE:HB	1:A:443:PRO:HD3	1.87	0.55
1:A:302:PHE:O	1:A:305:PHE:HB3	2.07	0.55
1:A:243:GLU:O	1:A:247:LYS:HG2	2.08	0.54
1:A:131:GLU:HB3	1:A:303:GLN:HG2	1.90	0.54
1:A:96:MET:HB2	1:A:97:PRO:HD3	1.89	0.54
1:A:197:VAL:HA	1:A:200:MET:HG3	1.90	0.54
1:A:25:ARG:HD2	1:A:234:CYS:O	2.08	0.53
1:A:95:ARG:NH2	1:A:328:SER:O	2.42	0.52
1:A:174:VAL:O	1:A:178:MET:HG3	2.10	0.51
1:A:256:GLN:O	1:A:260:MET:HG2	2.12	0.50
1:A:48:ALA:O	1:A:52:MET:HG2	2.12	0.49
1:A:215:ILE:HG21	1:A:360:ASN:HD22	1.77	0.49
1:A:376:ILE:HG13	1:A:437:ALA:HB1	1.94	0.49
1:A:324:TYR:O	1:A:328:SER:HB3	2.12	0.49
1:A:400:ILE:HG21	1:A:456:SER:HB2	1.94	0.49
1:A:274:SER:HB3	1:A:280:GLU:O	2.13	0.48
1:A:91:THR:HG23	1:A:107:ILE:HD13	1.95	0.48
1:A:69:CYS:HB3	1:A:261:VAL:HG22	1.95	0.48
1:A:352:PRO:HD2	1:A:353:TRP:CZ3	2.48	0.48
1:A:165:ARG:O	1:A:169:VAL:HG23	2.13	0.47
1:A:257:TRP:CE2	1:A:261:VAL:HG21	2.50	0.47
1:A:220:TRP:CD2	2:A:1467:5FH:H7	2.50	0.47
1:A:47:ILE:HG12	1:A:281:TRP:CE2	2.51	0.46
1:A:208:PRO:HG2	1:A:427:ASP:OD2	2.16	0.45
1:A:142:LEU:HB3	1:A:143:PRO:HD3	1.97	0.45
1:A:75:LEU:O	1:A:79:THR:HG23	2.16	0.45
1:A:52:MET:HE1	1:A:212:ALA:HB1	1.99	0.44
1:A:363:LEU:HD23	1:A:366:LEU:HD12	1.99	0.44
1:A:89:ASN:HA	1:A:89:ASN:HD22	1.58	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:362:PHE:O	1:A:365:LEU:HB2	2.17	0.43
1:A:422:SER:O	1:A:429:MET:HG2	2.19	0.43
1:A:94:ALA:O	1:A:97:PRO:HD2	2.18	0.43
1:A:37:PHE:HA	1:A:259:GLY:O	2.17	0.43
1:A:22:TYR:CZ	1:A:238:PRO:HB3	2.54	0.43
1:A:19:PRO:HD3	1:A:395:TYR:CZ	2.54	0.42
1:A:186:MET:HE3	1:A:286:ALA:HB1	2.02	0.42
1:A:141:ASN:OD1	1:A:143:PRO:HD2	2.20	0.42
1:A:97:PRO:O	1:A:408:ASN:ND2	2.53	0.42
1:A:17:ASN:HD22	1:A:328:SER:HA	1.83	0.42
1:A:214:MET:CE	1:A:430:PHE:HB3	2.50	0.42
1:A:122:THR:HG21	1:A:348:LEU:HD21	2.02	0.41
1:A:151:ALA:O	1:A:155:VAL:HG23	2.20	0.41
1:A:129:LEU:O	1:A:133:THR:HG23	2.21	0.41
1:A:131:GLU:O	1:A:135:LEU:HG	2.20	0.41
1:A:334:PHE:HE1	1:A:342:VAL:HG21	1.85	0.41
1:A:178:MET:HE2	1:A:305:PHE:HB2	2.02	0.41
1:A:155:VAL:HA	1:A:158:PHE:CD2	2.56	0.41
1:A:14:ASN:HB2	1:A:15:PRO:HD2	2.01	0.41
1:A:237:ASP:HA	1:A:238:PRO:HD2	1.91	0.41
1:A:132:ILE:CG1	1:A:303:GLN:HB3	2.51	0.41
1:A:383:LEU:HD13	1:A:442:ILE:HD11	2.03	0.41
1:A:113:LEU:HD13	1:A:366:LEU:HD22	2.01	0.41
1:A:207:MET:HA	1:A:208:PRO:HD3	1.93	0.40
1:A:302:PHE:CD1	1:A:302:PHE:C	2.95	0.40
1:A:391:LEU:HA	1:A:394:LEU:HD12	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	454/495 (92%)	406 (89%)	45 (10%)	3 (1%)	22 60

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	228	HIS
1	A	137	THR
1	A	138	GLY

### 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	367/399 (92%)	347 (95%)	20 (5%)	22 53

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	13	LEU
1	A	31	SER
1	A	85	ARG
1	A	89	ASN
1	A	114	SER
1	A	144	LEU
1	A	161	ILE
1	A	167	MET
1	A	241	SER
1	A	243	GLU
1	A	276	VAL
1	A	295	SER
1	A	311	TRP
1	A	312	SER
1	A	321	SER
1	A	332	ARG
1	A	355	PHE
1	A	365	LEU

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Mol	Chain	Res	Type
1	A	405	ARG
1	A	446	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	89	ASN
1	A	360	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](#)

Of 2 ligands modelled in this entry, 1 is monoatomic - leaving 1 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	$\# Z  > 2$
2	5FH	A	1467	-	15,15,15	3.56	7 (46%)	18,20,20	1.29	2 (11%)

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
2	5FH	A	1467	-	-	0/4/16/16	0/2/2/2

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1467	5FH	C3-C2	-7.00	1.47	1.52
2	A	1467	5FH	C1-N1	6.14	1.45	1.35
2	A	1467	5FH	C6-C10	5.03	1.49	1.38
2	A	1467	5FH	C7-C5	4.88	1.49	1.38
2	A	1467	5FH	C9-C8	4.37	1.49	1.38
2	A	1467	5FH	C2-N2	4.10	1.42	1.37
2	A	1467	5FH	C1-N2	3.22	1.45	1.39

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1467	5FH	C2-N2-C1	-3.98	108.11	111.60
2	A	1467	5FH	C4-C3-N1	-2.53	111.01	113.95

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1467	5FH	1	0

## 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

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.