



# wwPDB X-ray Structure Validation Summary Report ⓘ

Apr 7, 2022 – 05:00 PM EDT

PDB ID : 1FP7  
Title : MONOVALENT CATION BINDING SITES IN N10-FORMYLTETRAHYDROFOLATE SYNTHETASE FROM MOORELLA THERMOACETICA  
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Deposited on : 2000-08-30  
Resolution : 3.20 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](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)  
Xtrriage (Phenix) : **NOT EXECUTED**  
EDS : **NOT EXECUTED**  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.27

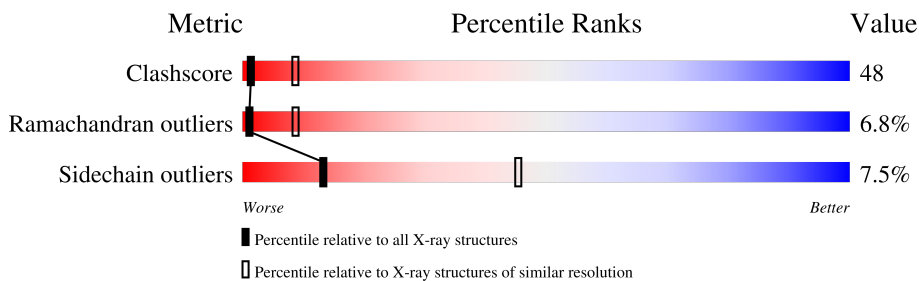
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.20 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	141614	1253 (3.20-3.20)
Ramachandran outliers	138981	1234 (3.20-3.20)
Sidechain outliers	138945	1233 (3.20-3.20)

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  $\geq 3$ , 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  $\leq 5\%$ .

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	557	
1	B	557	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	SO4	A	273	-	-	X	-
2	SO4	A	274	-	-	X	-
2	SO4	A	275	-	-	X	-
2	SO4	A	277	-	-	X	-

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<b>Mol</b>	<b>Type</b>	<b>Chain</b>	<b>Res</b>	<b>Chirality</b>	<b>Geometry</b>	<b>Clashes</b>	<b>Electron density</b>
2	SO4	A	278	-	-	X	-

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 8585 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.

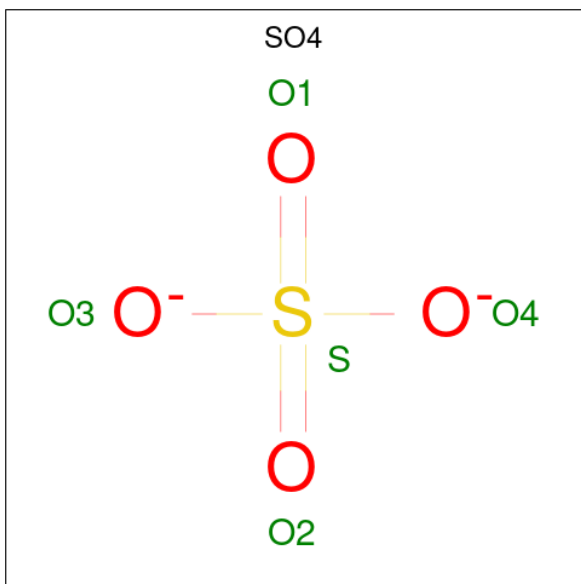
- Molecule 1 is a protein called FORMATE--TETRAHYDROFOLATE LIGASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	549	4133	2617	715	780	21	0	0	0
1	B	548	4125	2613	714	777	21	0	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	?	-	GLU	deletion	UNP P21164
A	?	-	VAL	deletion	UNP P21164
B	?	-	GLU	deletion	UNP P21164
B	?	-	VAL	deletion	UNP P21164

- Molecule 2 is SULFATE ION (three-letter code: SO<sub>4</sub>) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total O S 5 4 1	0	0
2	A	1	Total O S 5 4 1	0	0
2	A	1	Total O S 5 4 1	0	0
2	A	1	Total O S 5 4 1	0	0
2	A	1	Total O S 5 4 1	0	0
2	A	1	Total O S 5 4 1	0	0
2	A	1	Total O S 5 4 1	0	0
2	B	1	Total O S 5 4 1	0	0
2	B	1	Total O S 5 4 1	0	0
2	B	1	Total O S 5 4 1	0	0
2	B	1	Total O S 5 4 1	0	0

- Molecule 3 is POTASSIUM ION (three-letter code: K) (formula: K).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total K 2 2	0	1

- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	199	Total O 199 199	0	0
4	B	71	Total O 71 71	0	0



A1551	G1483	H1340	M1277	C1210	A1135	P1067
D1552	L1408	G1341	I1278	L1211	V1136	T1068
G1553	L1409	G1342	A1279	L1215	H1140	P1069
V1554	W1412	V1343	H1280	E1220	L1143	A1070
T1555	A1413	P1344	G1281	R1221	L1144	G1071
T1556	K1414	D1347	C1282	F1222	L1152	E1072
G1557	E1417	L1348	I1285	R1223	A1144	G1073
LEU	L1420	E1351	I1286	S1223	V1147	K1074
PHE	A1421	M1352	A1287	R1224	D1148	T1075
	L1422	L1353	T1288	I1225	N1149	T1076
	K1425	L1356	K1289	V1226	H1150	T1077
	V1426	R1357	T1290	V1227	L1151	S1078
	L1427	E1358	A1291	G1228	Q1152	V1079
	Q1428	G1359	L1292	Y1229	L1153	G1080
	T1429	F1360	K1293	T1230	G1154	L1081
	L1430	A1361	L1294	T1231	G1155	T1082
	E1431	M1362	A1295	D1232	V1156	D1083
	S1432	L1363	D1296	G1233	L1157	L1085
	R1433	E1364	D1297	K1234	M1158	A1086
	P1434	K1365	Y1298	P1235	L1159	R1087
	S1435	H1366	V1299	T1236	D1160	G1089
	M1436	H1367	T1300	T1237	L1088	L1089
	F1437	E1368	G1303	A1238	K1090	K1090
	H1438	M1369	F1304	G1239	R1091	V1092
	V1439	I1370	A1305	D1240	V1092	V1092
	L1440	G1371	G1306	Q1244	R1167	M1093
	Y1441	K1372	D1307	G1245	R1168	M1093
	N1442	F1373	L1308	S1246	I1170	V1094
	L1443	G1374	G1309	M1247	D1171	C1095
	D1444	V1375	A1310	A1248	L1172	L1096
	L1445	P1376	E1311	L1249	M1173	R1097
	S1446	A1377	K1312	I1250	D1174	P1103
	I1447	V1378	F1313	M1251	R1175	S1104
	K1448	V1379	Y1314	K1252	A1176	F1105
	D1449	A1380	D1315	D1253	L1177	G1106
	K1450	I1381	V1316	A1254	R1178	I1107
	I1451	M1382	K1317	I1255	K1108	K1108
	A1452	A1383	C1318	I1256	I1182	G1109
	K1453	F1384	R1319	K1256	G1110	G1110
	I1454	P1385	Y1320	P1257	A1111	A1111
	A1455	T1386	F1323	L1259	G1186	A1112
	T1456	D1387	K1324	V1260	K1187	G1113
	E1457	A1390	P1325	Q1261	A1188	G1114
	I1458	E1391	D1326	T1262	G1115	G1115
	Y1459	L1392	M1327	L1263	R1193	Y1116
	G1460	L1392	A1327	E1264	E1194	A1117
	A1461	M1393	T1328	N1265	T1195	Q1118
	D1462	L1394	V1329	T1266	G1196	V1119
	N1465	L1395	I1330	P1267	F1197	V1120
	Y1466	E1396	V1331	A1268	D1198	P1121
	L1466	L1397	A1332	F1269	S1200	D1124
	K1472	L1398	T1333	I1270	I1125	I1125
	R1476	C1399	V1334	G1271	S1203	S1203
	Y1477	A1400	R1335	G1273	A1204	F1129
	E1478	K1401	A1336	P1274	V1205	F1129
		A1402	L1337	F1275	M1206	D1132
		G1403	M1339	A1276	L1209	I1133
						H1134

## 4 Data and refinement statistics

Xtrriage (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, $\alpha$ , $\beta$ , $\gamma$	160.88Å 160.88Å 256.12Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	19.99 – 3.20	Depositor
% Data completeness (in resolution range)	87.2 (19.99-3.20)	Depositor
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	CNS	Depositor
R, $R_{free}$	0.285 , 0.355	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	8585	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	40.0	wwPDB-VP



## 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: SO4, K

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	0.44	0/4201	0.72	1/5690 (0.0%)
1	B	0.40	0/4193	0.68	0/5679
All	All	0.42	0/8394	0.70	1/11369 (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	1524	LEU	N-CA-C	5.35	125.44	111.00

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	4133	0	4219	357	0
1	B	4125	0	4211	448	0
2	A	35	0	0	14	0
2	B	20	0	0	2	0
3	A	2	0	0	1	0
4	A	199	0	0	28	0
4	B	71	0	0	16	0
All	All	8585	0	8430	806	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 48.

The worst 5 of 806 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:1175:ARG:HD3	2:A:275:SO4:O3	1.40	1.22
1:B:1222:PHE:O	1:B:1225:ILE:HG22	1.40	1.19
1:A:1007:ASP:OD2	4:A:32:HOH:O	1.68	1.11
1:B:1079:VAL:HB	1:B:1117:ALA:HB1	1.34	1.08
1:B:1335:ARG:HD3	1:B:1348:LEU:HB3	1.33	1.07

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	547/557 (98%)	437 (80%)	90 (16%)	20 (4%)	<b>3</b> <b>22</b>
1	B	546/557 (98%)	385 (70%)	107 (20%)	54 (10%)	<b>0</b> <b>3</b>
All	All	1093/1114 (98%)	822 (75%)	197 (18%)	74 (7%)	<b>1</b> <b>9</b>

5 of 74 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	1015	LYS
1	A	1304	PHE
1	A	1533	MET
1	A	1556	THR
1	B	1056	ASP

### 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	432/440 (98%)	401 (93%)	31 (7%)	14	47
1	B	431/440 (98%)	397 (92%)	34 (8%)	12	43
All	All	863/880 (98%)	798 (92%)	65 (8%)	13	45

5 of 65 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	1382	ASN
1	B	1499	ASP
1	A	1487	VAL
1	A	1449	ASP
1	B	1518	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 24 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	1140	HIS
1	B	1189	ASN
1	B	1153	GLN
1	B	1244	GLN
1	A	1261	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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 13 ligands modelled in this entry, 2 are monoatomic - leaving 11 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	SO4	A	273	-	4,4,4	0.82	0	6,6,6	0.50	0
2	SO4	B	272	1	4,4,4	0.82	0	6,6,6	0.50	0
2	SO4	B	280	-	4,4,4	0.82	0	6,6,6	0.50	0
2	SO4	A	271	-	4,4,4	0.82	0	6,6,6	0.50	0
2	SO4	A	275	-	4,4,4	0.82	0	6,6,6	0.50	0
2	SO4	B	281	-	4,4,4	0.82	0	6,6,6	0.50	0
2	SO4	A	274	1	4,4,4	0.82	0	6,6,6	0.50	0
2	SO4	A	276	-	4,4,4	0.82	0	6,6,6	0.50	0
2	SO4	A	278	1	4,4,4	0.82	0	6,6,6	0.50	0
2	SO4	A	277	-	4,4,4	0.82	0	6,6,6	0.50	0
2	SO4	B	279	1	4,4,4	0.82	0	6,6,6	0.50	0

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.

7 monomers are involved in 16 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	273	SO4	4	0
2	B	272	SO4	1	0
2	B	280	SO4	1	0
2	A	275	SO4	4	0

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Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	274	SO4	2	0
2	A	278	SO4	2	0
2	A	277	SO4	2	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 [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

EDS was not executed - this section is therefore empty.

### 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

EDS was not executed - this section is therefore empty.

### 6.3 Carbohydrates [i](#)

EDS was not executed - this section is therefore empty.

### 6.4 Ligands [i](#)

EDS was not executed - this section is therefore empty.

### 6.5 Other polymers [i](#)

EDS was not executed - this section is therefore empty.