



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 01:25 AM UTC

PDB ID : 1FM2 / pdb_00001fm2
Title : THE 2 ANGSTROM CRYSTAL STRUCTURE OF CEPHALOSPORIN
ACYLASE
Authors : Kim, Y.; Yoon, K.H.; Khang, Y.; Turley, S.; Hol, W.G.J.
Deposited on : 2000-08-15
Resolution : 2.00 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
Mogul	:	2022.3.0, CSD as543be (2022)
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

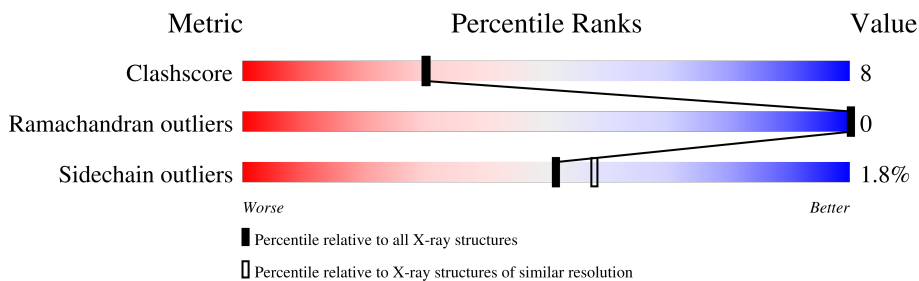
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)

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	169	 79% 11% • 10%
2	B	520	 81% 16% •

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5720 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 GLUTARYL 7-AMINOCEPHALOSPORANIC ACID ACYL-LASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	152	Total	C	N	O	Se	0	0	0
			1193	760	211	221	1			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	145	MSE	MET	modified residue	UNP Q9L5D6

- Molecule 2 is a protein called GLUTARYL 7-AMINOCEPHALOSPORANIC ACID ACYL-LASE.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	B	520	Total	C	N	O	S	Se	0	0	0
			4105	2590	729	773	1	12			

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	233	MSE	MET	modified residue	UNP Q9L5D6
B	242	MSE	MET	modified residue	UNP Q9L5D6
B	318	MSE	MET	modified residue	UNP Q9L5D6
B	325	MSE	MET	modified residue	UNP Q9L5D6
B	338	MSE	MET	modified residue	UNP Q9L5D6
B	341	MSE	MET	modified residue	UNP Q9L5D6
B	426	CYS	THR	SEE REMARK 999	UNP Q9L5D6
B	428	ALA	ARG	SEE REMARK 999	UNP Q9L5D6
B	429	ASN	ASP	SEE REMARK 999	UNP Q9L5D6
B	451	MSE	MET	modified residue	UNP Q9L5D6
B	463	MSE	MET	modified residue	UNP Q9L5D6
B	473	MSE	MET	modified residue	UNP Q9L5D6
B	506	ASP	GLU	SEE REMARK 999	UNP Q9L5D6

Continued on next page...

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
B	585	MSE	MET	modified residue	UNP Q9L5D6
B	629	MSE	MET	modified residue	UNP Q9L5D6
B	642	MSE	MET	modified residue	UNP Q9L5D6

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	110	Total 110	O 110	0	0
3	B	312	Total 312	O 312	0	0

3 Residue-property plots [i](#)

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.

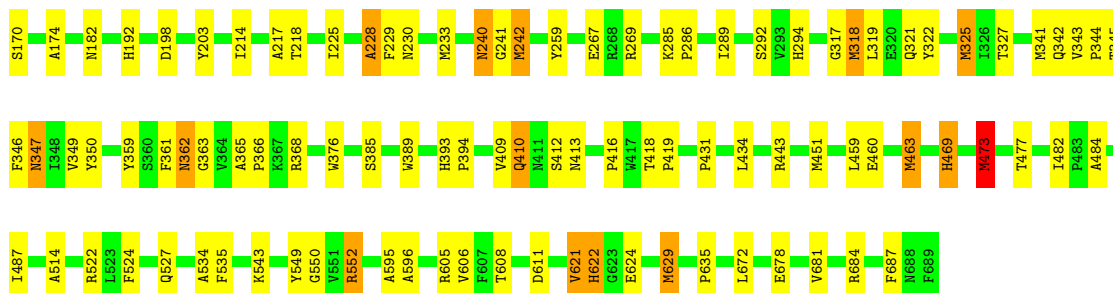
- Molecule 1: GLUTARYL 7-AMINOCEPHALOSPORANIC ACID ACYLASE

Chain A:  79% 11% • 10%



- Molecule 2: GLUTARYL 7-AMINOCEPHALOSPORANIC ACID ACYLASE

Chain B:  81% 16% •



4 Data and refinement statistics

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

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α , β , γ	73.60Å 73.60Å 380.90Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	40.00 – 2.00	Depositor
% Data completeness (in resolution range)	(Not available) (40.00-2.00)	Depositor
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.208 , 0.230	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	5720	wwPDB-VP
Average B, all atoms (Å ²)	27.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

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	0.40	1/1231 (0.1%)	0.90	4/1683 (0.2%)
2	B	0.53	6/4209 (0.1%)	0.91	18/5725 (0.3%)
All	All	0.50	7/5440 (0.1%)	0.90	22/7408 (0.3%)

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	473	MSE	SE-CE	-9.10	1.68	1.95
2	B	325	MSE	SE-CE	-6.77	1.75	1.95
2	B	318	MSE	SE-CE	-6.41	1.76	1.95
2	B	341	MSE	SE-CE	-6.17	1.76	1.95
2	B	463	MSE	SE-CE	-5.86	1.77	1.95
1	A	145	MSE	SE-CE	-5.14	1.80	1.95
2	B	242	MSE	SE-CE	-5.07	1.80	1.95

All (22) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	606	VAL	N-CA-C	8.25	120.49	108.53
1	A	70	GLY	CA-C-N	8.21	128.69	119.32
1	A	70	GLY	C-N-CA	8.21	128.69	119.32
2	B	267	GLU	N-CA-C	-7.01	97.83	109.46
2	B	347	ASN	N-CA-C	-6.26	99.44	109.96
2	B	543	LYS	CA-C-N	6.16	125.84	119.56
2	B	543	LYS	C-N-CA	6.16	125.84	119.56
2	B	344	PRO	N-CA-C	5.95	121.35	114.03
1	A	51	GLY	N-CA-C	5.80	119.66	112.64
2	B	362	ASN	N-CA-C	5.45	118.59	110.52
2	B	621	VAL	N-CA-C	-5.45	107.05	113.42
2	B	605	ARG	N-CA-C	-5.44	101.11	109.76
2	B	611	ASP	N-CA-C	-5.40	102.62	110.08
2	B	198	ASP	N-CA-C	5.39	117.58	111.11
1	A	146	ASN	N-CA-C	5.30	118.91	112.23

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	482	ILE	CB-CA-C	-5.25	108.71	113.70
2	B	292	SER	N-CA-C	-5.24	102.40	109.95
2	B	514	ALA	N-CA-C	5.21	117.36	111.11
2	B	343	VAL	CA-C-N	5.15	125.23	119.87
2	B	343	VAL	C-N-CA	5.15	125.23	119.87
2	B	228	ALA	N-CA-C	5.12	117.94	109.85
2	B	477	THR	N-CA-C	5.03	119.76	113.43

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	1193	0	1114	15	0
2	B	4105	0	3917	79	0
3	A	110	0	0	4	0
3	B	312	0	0	5	0
All	All	5720	0	5031	87	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 8.

All (87) 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)
2:B:463:MSE:HG2	2:B:629:MSE:HG3	1.27	1.11
2:B:413:ASN:HD22	2:B:443:ARG:HH22	1.09	1.00
2:B:459:LEU:HG	2:B:463:MSE:HE2	1.43	1.00
2:B:321:GLN:HE22	2:B:342:GLN:H	1.04	0.91
2:B:322:TYR:HA	2:B:325:MSE:HE3	1.56	0.86
2:B:473:MSE:HE1	2:B:535:PHE:HZ	1.41	0.84
1:A:138:VAL:HA	3:A:255:HOH:O	1.81	0.80
2:B:473:MSE:HE1	2:B:535:PHE:CZ	2.16	0.79
2:B:321:GLN:NE2	2:B:342:GLN:H	1.79	0.79

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:321:GLN:HG2	2:B:325:MSE:HE2	1.65	0.78
2:B:317:GLY:H	2:B:342:GLN:HE21	1.36	0.73
2:B:460:GLU:HA	2:B:463:MSE:HE3	1.70	0.72
2:B:524:PHE:CE1	2:B:534:ALA:HB1	2.24	0.72
2:B:170:SER:N	2:B:413:ASN:HD21	1.89	0.71
2:B:242:MSE:HE2	3:B:877:HOH:O	1.92	0.69
1:A:88:ARG:HH11	1:A:142:HIS:HE2	1.42	0.67
2:B:463:MSE:CG	2:B:629:MSE:HG3	2.17	0.66
2:B:242:MSE:HE3	2:B:242:MSE:HA	1.79	0.63
2:B:431:PRO:HG2	2:B:434:LEU:HG	1.80	0.63
2:B:361:PHE:CD1	2:B:416:PRO:HG3	2.38	0.59
1:A:35:ALA:HB3	1:A:36:PRO:HD3	1.86	0.57
2:B:240:ASN:HB3	2:B:347:ASN:ND2	2.19	0.57
2:B:534:ALA:HB2	3:B:901:HOH:O	2.07	0.54
1:A:16:ARG:HB2	1:A:16:ARG:HH11	1.72	0.53
1:A:10:ILE:HG21	2:B:635:PRO:HB3	1.89	0.53
2:B:321:GLN:O	2:B:325:MSE:HG3	2.08	0.53
1:A:21:LEU:CD2	2:B:684:ARG:HG2	2.39	0.53
1:A:86:PRO:HG2	3:A:247:HOH:O	2.08	0.53
2:B:359:TYR:OH	2:B:416:PRO:HB3	2.10	0.53
2:B:595:ALA:O	2:B:596:ALA:HB3	2.09	0.52
2:B:368:ARG:HD2	2:B:376:TRP:CE2	2.44	0.52
1:A:10:ILE:HD13	2:B:635:PRO:HB3	1.93	0.51
2:B:552:ARG:HH11	2:B:552:ARG:HB3	1.75	0.51
2:B:321:GLN:HE22	2:B:342:GLN:N	1.89	0.50
2:B:459:LEU:O	2:B:463:MSE:HG3	2.12	0.49
2:B:174:ALA:HB3	2:B:409:VAL:CG2	2.43	0.49
1:A:30:ILE:HD13	1:A:42:TYR:HA	1.94	0.49
2:B:174:ALA:HB3	2:B:409:VAL:HG22	1.95	0.48
2:B:294:HIS:HE1	3:B:865:HOH:O	1.96	0.48
2:B:522:ARG:HD3	2:B:527:GLN:HE22	1.78	0.48
2:B:182:ASN:ND2	3:B:911:HOH:O	2.47	0.48
2:B:366:PRO:HB3	2:B:389:TRP:CD2	2.48	0.48
2:B:345:THR:O	2:B:346:PHE:HB2	2.14	0.48
2:B:524:PHE:CE1	2:B:534:ALA:CB	2.97	0.48
1:A:23:ASP:OD1	1:A:23:ASP:C	2.56	0.47
2:B:410:GLN:CD	2:B:410:GLN:C	2.82	0.47
2:B:451:MSE:HA	2:B:451:MSE:HE2	1.96	0.47
2:B:418:THR:O	2:B:418:THR:HG22	2.14	0.47
2:B:317:GLY:H	2:B:342:GLN:NE2	2.08	0.46
2:B:321:GLN:NE2	2:B:342:GLN:HB2	2.30	0.46

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:240:ASN:HD22	2:B:240:ASN:H	1.63	0.45
2:B:230:ASN:HB2	3:B:902:HOH:O	2.16	0.45
2:B:240:ASN:HB3	2:B:347:ASN:CG	2.41	0.45
2:B:469:HIS:HB2	2:B:596:ALA:HA	1.97	0.45
2:B:242:MSE:SE	2:B:365:ALA:HB2	2.67	0.44
2:B:549:TYR:CG	2:B:550:GLY:N	2.85	0.44
2:B:218:THR:HB	2:B:225:ILE:HA	1.98	0.44
2:B:192:HIS:HE1	2:B:624:GLU:OE1	2.00	0.44
2:B:678:GLU:O	2:B:681:VAL:HG12	2.18	0.43
3:A:255:HOH:O	2:B:319:LEU:CD1	2.67	0.43
2:B:174:ALA:HB2	2:B:349:VAL:CG1	2.48	0.43
2:B:203:TYR:O	2:B:217:ALA:HA	2.18	0.43
1:A:56:ARG:HD2	3:A:273:HOH:O	2.18	0.43
2:B:170:SER:O	2:B:412:SER:HA	2.19	0.43
2:B:350:TYR:CD2	2:B:350:TYR:C	2.96	0.43
2:B:259:TYR:OH	2:B:385:SER:HA	2.18	0.42
2:B:240:ASN:HD22	2:B:241:GLY:N	2.17	0.42
1:A:18:ASN:HB3	2:B:687:PHE:CE1	2.54	0.42
2:B:321:GLN:HE21	2:B:342:GLN:HB2	1.85	0.42
2:B:418:THR:N	2:B:419:PRO:CD	2.83	0.41
2:B:241:GLY:O	2:B:242:MSE:C	2.63	0.41
1:A:21:LEU:HD22	2:B:684:ARG:HG2	2.01	0.41
2:B:412:SER:O	2:B:413:ASN:HB2	2.20	0.41
2:B:362:ASN:CG	2:B:363:GLY:N	2.78	0.41
2:B:608:THR:OG1	2:B:622:HIS:HD2	2.03	0.41
2:B:393:HIS:HA	2:B:394:PRO:HD3	1.83	0.41
2:B:629:MSE:SE	2:B:629:MSE:N	3.03	0.41
1:A:141:ALA:HB1	2:B:318:MSE:CE	2.51	0.41
1:A:18:ASN:HB3	2:B:687:PHE:CZ	2.56	0.41
2:B:484:ALA:O	2:B:487:ILE:HG12	2.20	0.41
2:B:214:ILE:HD11	2:B:327:THR:CG2	2.50	0.40
2:B:214:ILE:HG23	2:B:228:ALA:HB1	2.03	0.40
2:B:317:GLY:N	2:B:342:GLN:HE21	2.12	0.40
2:B:229:PHE:HA	2:B:233:MSE:O	2.22	0.40
2:B:214:ILE:HG22	2:B:225:ILE:HD12	2.04	0.40
2:B:269:ARG:NH2	2:B:289:ILE:HD12	2.37	0.40
2:B:285:LYS:HA	2:B:286:PRO:HD3	1.86	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	150/169 (89%)	145 (97%)	5 (3%)	0	100	100
2	B	518/520 (100%)	507 (98%)	11 (2%)	0	100	100
All	All	668/689 (97%)	652 (98%)	16 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	116/129 (90%)	115 (99%)	1 (1%)	70	78
2	B	428/416 (103%)	419 (98%)	9 (2%)	47	52
All	All	544/545 (100%)	534 (98%)	10 (2%)	51	58

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	16	ARG
2	B	240	ASN
2	B	410	GLN
2	B	469	HIS
2	B	473	MSE
2	B	552	ARG
2	B	621	VAL
2	B	622	HIS

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
2	B	629	MSE
2	B	672	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (20) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	146	ASN
2	B	192	HIS
2	B	206	HIS
2	B	240	ASN
2	B	247	ASN
2	B	262	GLN
2	B	294	HIS
2	B	321	GLN
2	B	329	HIS
2	B	342	GLN
2	B	362	ASN
2	B	377	GLN
2	B	379	ASN
2	B	410	GLN
2	B	413	ASN
2	B	429	ASN
2	B	437	GLN
2	B	466	GLN
2	B	527	GLN
2	B	622	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry

There are no ligands in this entry.

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

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.