



Full wwPDB EM Validation Report ⓘ

Apr 19, 2026 – 05:19 AM UTC

PDB ID : 6ZHJ / pdb_00006zhj
Title : 3D electron diffraction structure of thermolysin from *Bacillus thermoproteolyticus*
Authors : Blum, T.; Housset, D.; Clabbers, M.T.B.; van Genderen, E.; Schoehn, G.; Ling, W.L.; Abrahams, J.P.
Deposited on : 2020-06-23
Resolution : 3.26 Å(reported)

This is a Full wwPDB EM Validation Report for a publicly released PDB/EMDB entry.

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A user guide is available at

<https://www.wwpdb.org/validation/2017/EMValidationReportHelp>
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
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

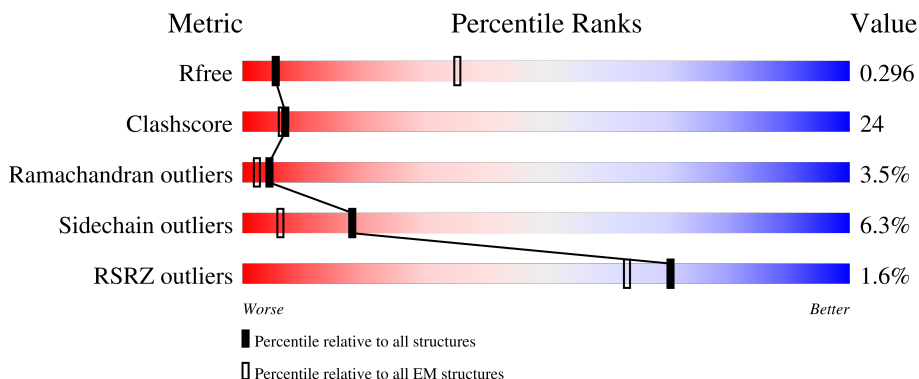
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON CRYSTALLOGRAPHY

The reported resolution of this entry is 3.26 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)	EM structures (#Entries)
R_{free}	180332	208
Clashscore	229148	23984
Ramachandran outliers	224038	23583
Sidechain outliers	223484	23102
RSRZ outliers	180361	209

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the 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 $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	A	316	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2438 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, 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 Thermolysin.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	316	Total	C	N	O	S	1	0
			2433	1528	410	493	2		

- Molecule 2 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		AltConf
2	A	1	Total	Zn	0
			1	1	

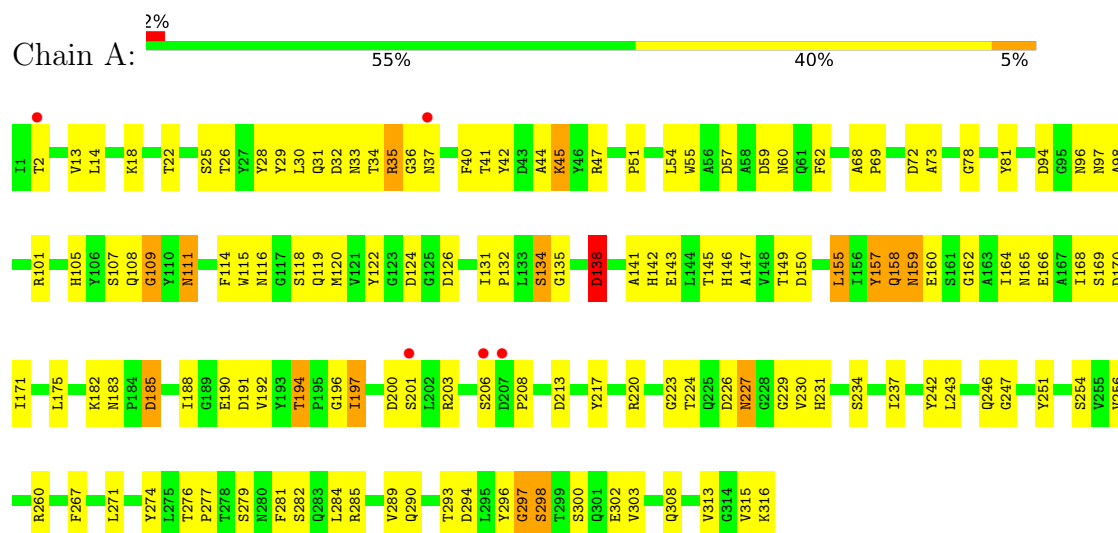
- Molecule 3 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		AltConf
3	A	4	Total	Ca	0
			4	4	

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. 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: Thermolysin



4 Data and refinement statistics

Property	Value	Source
Space group	P 61 2 2	Depositor
Cell constants a, b, c, α , β , γ	92.00Å 92.00Å 127.48Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	37.52 – 3.26 37.52 – 3.26	Depositor EDS
% Data completeness (in resolution range)	84.2 (37.52-3.26) 84.2 (37.52-3.26)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.31 (at 3.25Å)	Xtriage
Refinement program	REFMAC 5.8.0230	Depositor
R, R_{free}	0.210 , 0.292 0.227 , 0.296	Depositor DCC
R_{free} test set	237 reflections (4.41%)	wwPDB-VP
Wilson B-factor (Å ²)	39.2	Xtriage
Anisotropy	0.308	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.22 , 16.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.33$, $\langle L^2 \rangle = 0.16$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.83	EDS
Total number of atoms	2438	wwPDB-VP
Average B, all atoms (Å ²)	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.95% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: ZN, CA

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	0.72	0/2497	1.08	6/3399 (0.2%)

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	3

There are no bond length outliers.

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	59	ASP	CA-CB-CG	6.03	118.63	112.60
1	A	256	VAL	CA-C-N	5.60	125.66	120.34
1	A	256	VAL	C-N-CA	5.60	125.66	120.34
1	A	134	SER	CA-C-N	5.57	126.16	119.98
1	A	134	SER	C-N-CA	5.57	126.16	119.98
1	A	138	ASP	CA-CB-CG	5.56	118.16	112.60

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	101	ARG	Sidechain
1	A	35	ARG	Sidechain
1	A	47	ARG	Sidechain

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	2433	0	2273	113	0
2	A	1	0	0	0	0
3	A	4	0	0	0	0
All	All	2438	0	2273	113	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 24.

All (113) 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:254:SER:O	1:A:308:GLN:NE2	2.03	0.91
1:A:142:HIS:NE2	1:A:146:HIS:NE2	2.19	0.90
1:A:111:ASN:HD21	1:A:126:ASP:HB3	1.36	0.88
1:A:274:TYR:OH	1:A:294:ASP:OD2	1.93	0.86
1:A:285:ARG:NH1	1:A:315:VAL:O	2.18	0.77
1:A:171:ILE:O	1:A:175:LEU:HG	1.89	0.73
1:A:120:MET:HE1	1:A:143:GLU:CB	2.21	0.70
1:A:69:PRO:HA	1:A:134:SER:OG	1.92	0.69
1:A:160:GLU:OE2	1:A:217:TYR:OH	2.10	0.68
1:A:36:GLY:HA2	1:A:97:ASN:CG	2.18	0.68
1:A:114:PHE:HA	1:A:143:GLU:CD	2.22	0.65
1:A:142:HIS:CD2	1:A:146:HIS:NE2	2.66	0.64
1:A:13:VAL:N	1:A:72:ASP:OD2	2.26	0.64
1:A:120:MET:SD	1:A:143:GLU:C	2.82	0.63
1:A:158:GLN:OE1	1:A:227:ASN:ND2	2.32	0.62
1:A:51:PRO:HB3	1:A:119:GLN:HE22	1.64	0.61
1:A:28:TYR:CD2	1:A:60:ASN:HB2	2.34	0.61
1:A:114:PHE:HA	1:A:143:GLU:OE1	2.01	0.60
1:A:28:TYR:CE2	1:A:60:ASN:HB2	2.37	0.59
1:A:14:LEU:HD11	1:A:191:ASP:HB2	1.84	0.59
1:A:111:ASN:ND2	1:A:126:ASP:HB3	2.11	0.59
1:A:120:MET:HE2	1:A:122:TYR:CZ	2.37	0.59
1:A:73:ALA:HB2	1:A:134:SER:HB3	1.85	0.59
1:A:120:MET:HE1	1:A:143:GLU:HB2	1.83	0.58

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:22:THR:HG22	1:A:30:LEU:HD23	1.84	0.58
1:A:131:ILE:HB	1:A:132:PRO:HD2	1.85	0.57
1:A:94:ASP:CG	1:A:98:ALA:HB2	2.30	0.57
1:A:171:ILE:HD13	1:A:267:PHE:CE2	2.39	0.57
1:A:131:ILE:O	1:A:132:PRO:C	2.47	0.56
1:A:57:ASP:OD2	1:A:60:ASN:N	2.39	0.56
1:A:18:LYS:NZ	1:A:72:ASP:OD1	2.39	0.56
1:A:135:GLY:HA3	1:A:192:VAL:HG11	1.88	0.55
1:A:168:ILE:HG21	1:A:271:LEU:HD13	1.89	0.55
1:A:120:MET:SD	1:A:143:GLU:CB	2.94	0.55
1:A:274:TYR:CE1	1:A:290:GLN:HG2	2.42	0.55
1:A:31:GLN:OE1	1:A:33:ASN:ND2	2.36	0.55
1:A:138:ASP:N	1:A:138:ASP:OD1	2.40	0.55
1:A:164:ILE:HD12	1:A:279:SER:O	2.06	0.54
1:A:226:ASP:HB3	1:A:229:GLY:HA2	1.87	0.54
1:A:120:MET:HE1	1:A:143:GLU:HB3	1.88	0.54
1:A:96:ASN:O	1:A:97:ASN:C	2.51	0.54
1:A:188:ILE:HG13	1:A:203:ARG:HB2	1.91	0.53
1:A:73:ALA:HB2	1:A:134:SER:CB	2.38	0.53
1:A:69:PRO:HG2	1:A:105:HIS:CE1	2.44	0.53
1:A:141:ALA:O	1:A:145:THR:N	2.28	0.52
1:A:51:PRO:HB3	1:A:119:GLN:NE2	2.25	0.52
1:A:111:ASN:N	1:A:111:ASN:HD22	2.07	0.52
1:A:157:TYR:CE1	1:A:165:ASN:ND2	2.77	0.52
1:A:13:VAL:CG2	1:A:132:PRO:HB2	2.40	0.52
1:A:51:PRO:CB	1:A:119:GLN:HE22	2.23	0.52
1:A:185:ASP:N	1:A:185:ASP:OD1	2.41	0.51
1:A:142:HIS:CD2	1:A:146:HIS:CD2	2.99	0.51
1:A:108:GLN:O	1:A:109:GLY:C	2.52	0.51
1:A:42:TYR:HB2	1:A:51:PRO:O	2.12	0.49
1:A:115:TRP:CE2	1:A:147:ALA:HB2	2.47	0.49
1:A:120:MET:CE	1:A:143:GLU:HB3	2.41	0.49
1:A:194:THR:O	1:A:194:THR:OG1	2.29	0.49
1:A:120:MET:SD	1:A:143:GLU:HB3	2.52	0.49
1:A:159:ASN:O	1:A:160:GLU:C	2.56	0.49
1:A:298:SER:HA	1:A:303:VAL:HG21	1.95	0.49
1:A:234:SER:O	1:A:237:ILE:N	2.45	0.48
1:A:166:GLU:O	1:A:170:ASP:N	2.45	0.48
1:A:147:ALA:O	1:A:150:ASP:HB2	2.14	0.48
1:A:30:LEU:HD21	1:A:62:PHE:CE2	2.49	0.47
1:A:32:ASP:C	1:A:32:ASP:OD1	2.57	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:116:ASN:OD1	1:A:118:SER:N	2.46	0.47
1:A:217:TYR:O	1:A:220:ARG:NH1	2.45	0.47
1:A:243:LEU:O	1:A:247:GLY:N	2.41	0.47
1:A:281:PHE:O	1:A:284:LEU:HB3	2.14	0.47
1:A:81:TYR:C	1:A:81:TYR:CD1	2.92	0.47
1:A:120:MET:CE	1:A:143:GLU:CB	2.91	0.47
1:A:13:VAL:HG21	1:A:132:PRO:HB2	1.97	0.47
1:A:41:THR:O	1:A:54:LEU:HD12	2.15	0.47
1:A:28:TYR:CD1	1:A:60:ASN:CG	2.93	0.46
1:A:94:ASP:CG	1:A:96:ASN:H	2.23	0.46
1:A:115:TRP:CD2	1:A:147:ALA:HB2	2.50	0.46
1:A:13:VAL:HG12	1:A:131:ILE:HD12	1.98	0.46
1:A:196:GLY:C	1:A:197:ILE:HG13	2.41	0.46
1:A:116:ASN:OD1	1:A:116:ASN:C	2.59	0.46
1:A:296:TYR:O	1:A:300:SER:HB3	2.16	0.45
1:A:31:GLN:NE2	1:A:40:PHE:CE2	2.84	0.45
1:A:29:TYR:HA	1:A:55:TRP:O	2.16	0.45
1:A:230:VAL:HG23	1:A:231:HIS:ND1	2.31	0.45
1:A:282:SER:OG	1:A:316:LYS:O	2.32	0.44
1:A:35:ARG:NH1	1:A:78:GLY:HA3	2.32	0.44
1:A:28:TYR:O	1:A:57:ASP:N	2.48	0.44
1:A:242:TYR:CE1	1:A:246:GLN:HG3	2.52	0.44
1:A:282:SER:O	1:A:285:ARG:HB3	2.18	0.43
1:A:159:ASN:O	1:A:162:GLY:N	2.51	0.43
1:A:30:LEU:HD21	1:A:62:PHE:CZ	2.53	0.43
1:A:28:TYR:CG	1:A:60:ASN:HB2	2.53	0.43
1:A:142:HIS:CD2	1:A:142:HIS:C	2.97	0.43
1:A:68:ALA:N	1:A:69:PRO:CD	2.82	0.43
1:A:145:THR:HG21	1:A:169:SER:HA	1.99	0.42
1:A:293:THR:O	1:A:297:GLY:N	2.53	0.42
1:A:289:VAL:HG13	1:A:303:VAL:HG13	2.01	0.42
1:A:276:THR:O	1:A:277:PRO:C	2.63	0.42
1:A:42:TYR:CD2	1:A:54:LEU:N	2.88	0.42
1:A:32:ASP:OD1	1:A:34:THR:OG1	2.25	0.42
1:A:37:ASN:CG	1:A:97:ASN:O	2.63	0.42
1:A:105:HIS:ND1	1:A:124:ASP:OD1	2.53	0.42
1:A:155:LEU:HA	1:A:277:PRO:HA	2.01	0.41
1:A:28:TYR:CZ	1:A:60:ASN:HB2	2.55	0.41
1:A:44:ALA:O	1:A:45:LYS:HB2	2.21	0.41
1:A:190:GLU:N	1:A:190:GLU:CD	2.79	0.41
1:A:296:TYR:O	1:A:300:SER:CB	2.69	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:300:SER:HB2	1:A:302:GLU:OE1	2.21	0.41
1:A:42:TYR:CD2	1:A:54:LEU:HA	2.56	0.40
1:A:51:PRO:CA	1:A:119:GLN:HE22	2.35	0.40
1:A:120:MET:CE	1:A:143:GLU:HB2	2.50	0.40
1:A:182:LYS:O	1:A:183:ASN:C	2.64	0.40
1:A:208:PRO:CB	1:A:213:ASP:HB2	2.52	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 PDB entries followed by that with respect to all EM entries.

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	315/316 (100%)	256 (81%)	48 (15%)	11 (4%)	3 17

All (11) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	109	GLY
1	A	45	LYS
1	A	159	ASN
1	A	223	GLY
1	A	251	TYR
1	A	297	GLY
1	A	25	SER
1	A	26	THR
1	A	194	THR
1	A	197	ILE
1	A	313	VAL

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 PDB entries followed by that with respect to all EM entries.

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	253/252 (100%)	237 (94%)	16 (6%)	16	43

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	2	THR
1	A	107	SER
1	A	111	ASN
1	A	138	ASP
1	A	149	THR
1	A	155	LEU
1	A	157	TYR
1	A	158	GLN
1	A	185	ASP
1	A	200	ASP
1	A	201	SER
1	A	206	SER
1	A	224	THR
1	A	227	ASN
1	A	260	ARG
1	A	298	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	21	ASN
1	A	111	ASN
1	A	119	GLN
1	A	227	ASN
1	A	283	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 5 ligands modelled in this entry, 5 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.