



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 11:51 AM UTC

PDB ID : 1EF7 / pdb_00001ef7
Title : CRYSTAL STRUCTURE OF HUMAN CATHEPSIN X
Authors : Guncar, G.; Klemencic, I.; Turk, B.; Turk, V.; Karaoglanovic-Carmona, A.;
Juliano, L.; Turk, D.
Deposited on : 2000-02-07
Resolution : 2.67 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
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

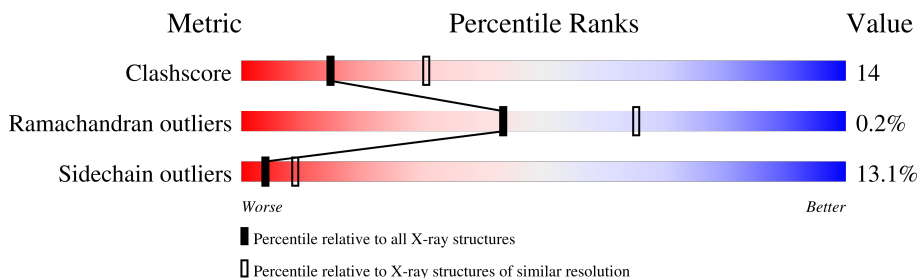
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.67 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	5409 (2.70-2.66)
Ramachandran outliers	187476	5324 (2.70-2.66)
Sidechain outliers	187428	5324 (2.70-2.66)

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	242	 67% 29% •
1	B	242	 65% 29% 6%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3934 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 CATHEPSIN X.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	242	Total	C	N	O	S	19	0	0
			1908	1188	337	368	15			
1	B	242	Total	C	N	O	S	8	0	0
			1908	1188	337	368	15			

- Molecule 2 is water.

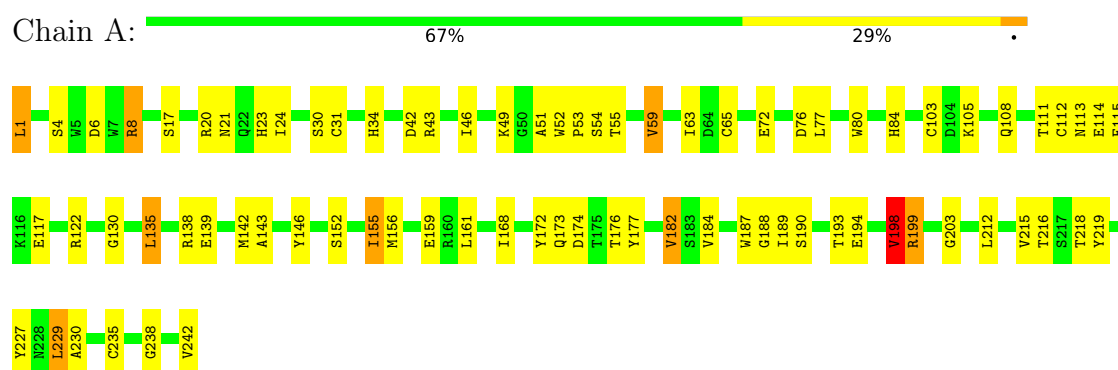
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	63	Total	O	0	0
			63	63		
2	B	55	Total	O	0	0
			55	55		

3 Residue-property plots

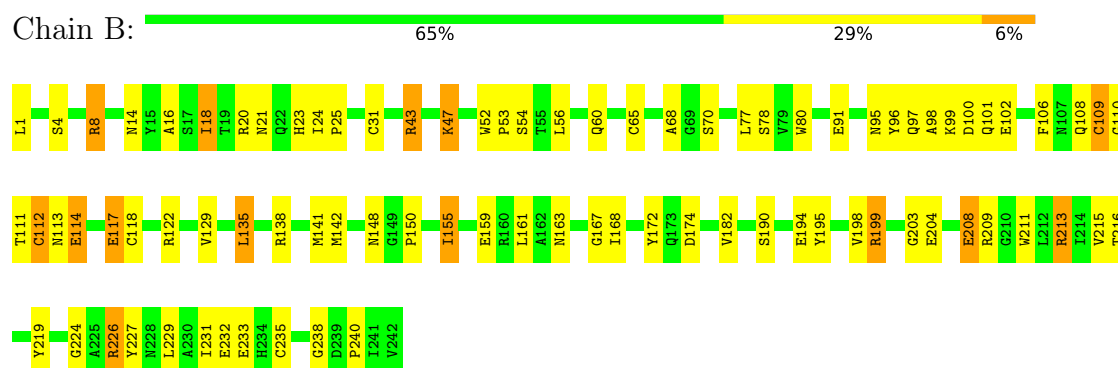
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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.

Note EDS was not executed.

• Molecule 1: CATHEPSIN X



• Molecule 1: CATHEPSIN X



4 Data and refinement statistics

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

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	62.25Å 92.48Å 209.88Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 2.67	Depositor
% Data completeness (in resolution range)	(Not available) (10.00-2.67)	Depositor
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	MAIN	Depositor
R, R_{free}	0.183 , 0.226	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	3934	wwPDB-VP
Average B, all atoms (Å ²)	25.0	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	0.67	0/1960	1.00	6/2664 (0.2%)
1	B	0.72	0/1960	1.08	8/2664 (0.3%)
All	All	0.69	0/3920	1.04	14/5328 (0.3%)

There are no bond length outliers.

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	23	HIS	N-CA-C	6.53	120.24	112.93
1	A	65	CYS	N-CA-C	6.25	120.22	112.59
1	A	103	CYS	N-CA-C	6.21	119.65	108.17
1	B	65	CYS	N-CA-C	5.97	120.26	112.92
1	B	102	GLU	N-CA-C	-5.93	102.71	110.53
1	B	54	SER	N-CA-C	-5.77	101.74	110.28
1	B	112	CYS	N-CA-C	-5.71	106.12	112.57
1	A	108	GLN	N-CA-C	-5.52	104.90	111.69
1	A	54	SER	N-CA-C	-5.32	102.41	110.28
1	B	233	GLU	N-CA-C	5.30	117.14	111.36
1	B	18	ILE	N-CA-C	5.16	116.67	109.55
1	A	23	HIS	N-CA-C	5.12	119.25	113.15
1	A	198	VAL	N-CA-C	5.06	116.00	108.46
1	B	215	VAL	N-CA-C	5.05	116.10	109.58

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	1908	0	1760	44	0
1	B	1908	0	1760	57	0
2	A	63	0	0	4	0
2	B	55	0	0	2	0
All	All	3934	0	3520	101	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 14.

All (101) 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:156:MET:HE3	1:A:177:TYR:CE1	2.19	0.77
1:B:199:ARG:HD2	2:B:290:HOH:O	1.88	0.74
1:B:141:MET:HE3	1:B:235:CYS:SG	2.32	0.68
1:B:135:LEU:CD2	1:B:235:CYS:HB2	2.24	0.68
1:A:156:MET:HE3	1:A:177:TYR:HE1	1.58	0.67
1:A:6:ASP:OD1	1:A:8:ARG:HD3	1.96	0.66
1:A:135:LEU:CD2	1:A:235:CYS:HB2	2.27	0.64
1:A:199:ARG:HD2	2:A:278:HOH:O	1.97	0.63
1:A:182:VAL:HG22	1:A:199:ARG:O	1.98	0.63
1:B:20:ARG:HE	1:B:56:LEU:HD11	1.63	0.62
1:B:114:GLU:HB2	1:B:117:GLU:HB2	1.83	0.60
1:A:17:SER:O	1:A:199:ARG:NH2	2.34	0.60
1:A:156:MET:HE1	1:A:173:GLN:NE2	2.17	0.59
1:A:142:MET:HE3	1:A:187:TRP:CZ2	2.38	0.58
1:B:43:ARG:HG2	1:B:148:ASN:O	2.05	0.57
1:A:182:VAL:HG11	1:A:198:VAL:HG21	1.87	0.56
1:B:21:ASN:HB2	1:B:203:GLY:CA	2.35	0.56
1:A:80:TRP:CE3	1:A:238:GLY:HA3	2.39	0.56
1:A:168:ILE:HD11	1:A:190:SER:HB3	1.87	0.56
1:B:8:ARG:HD2	1:B:211:TRP:CZ3	2.40	0.56
1:A:20:ARG:NH1	2:A:252:HOH:O	2.38	0.55
1:B:135:LEU:C	1:B:135:LEU:HD23	2.31	0.55
1:B:168:ILE:HD11	1:B:190:SER:HB3	1.88	0.55
1:A:172:TYR:HB2	1:A:227:TYR:CE2	2.41	0.55
1:B:21:ASN:HB2	1:B:203:GLY:HA2	1.87	0.55
1:A:112:CYS:HA	1:A:117:GLU:O	2.07	0.55
1:A:135:LEU:HD21	1:A:235:CYS:HB2	1.88	0.54
1:A:135:LEU:HD23	1:A:235:CYS:HB2	1.88	0.54
1:B:20:ARG:NE	1:B:56:LEU:HD11	2.22	0.54
1:A:30:SER:HB3	1:A:63:ILE:HD11	1.90	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:172:TYR:HB2	1:B:227:TYR:CE2	2.43	0.53
1:B:138:ARG:O	1:B:142:MET:HG3	2.09	0.53
1:B:112:CYS:O	1:B:114:GLU:O	2.26	0.52
1:B:114:GLU:HB2	1:B:117:GLU:CB	2.40	0.52
1:A:51:ALA:HA	2:A:259:HOH:O	2.11	0.51
1:B:172:TYR:CE1	1:B:226:ARG:HG2	2.46	0.51
1:B:70:SER:HB2	1:B:100:ASP:OD1	2.11	0.51
1:A:84:HIS:ND1	1:A:130:GLY:O	2.44	0.50
1:B:195:TYR:CD2	1:B:213:ARG:HG2	2.48	0.49
1:B:80:TRP:CE3	1:B:238:GLY:HA3	2.47	0.49
1:B:199:ARG:HB2	1:B:211:TRP:CZ2	2.48	0.49
1:A:76:ASP:HB3	2:A:302:HOH:O	2.12	0.49
1:B:231:ILE:HG23	1:B:232:GLU:HG2	1.95	0.49
1:B:172:TYR:OH	1:B:174:ASP:HB3	2.14	0.48
1:A:156:MET:O	1:A:229:LEU:HG	2.13	0.48
1:B:112:CYS:HA	1:B:118:CYS:HA	1.94	0.48
1:A:152:SER:O	1:A:235:CYS:HA	2.13	0.48
1:A:21:ASN:HB2	1:A:203:GLY:HA2	1.95	0.48
1:A:215:VAL:HB	1:A:219:TYR:HB2	1.96	0.48
1:B:111:THR:HG23	1:B:113:ASN:HB2	1.95	0.48
1:B:199:ARG:HB2	1:B:211:TRP:CE2	2.49	0.48
1:B:68:ALA:HB1	1:B:78:SER:HB2	1.95	0.47
1:A:1:LEU:HD21	1:A:143:ALA:HA	1.96	0.47
1:B:112:CYS:O	1:B:113:ASN:C	2.58	0.47
1:B:168:ILE:HD11	1:B:190:SER:CB	2.45	0.47
1:A:138:ARG:O	1:A:142:MET:HG3	2.14	0.47
1:A:194:GLU:HG2	1:A:216:THR:HG21	1.97	0.47
1:B:47:LYS:HD2	1:B:240:PRO:HG2	1.97	0.47
1:A:188:GLY:O	1:A:194:GLU:HA	2.15	0.46
1:B:96:TYR:CE2	1:B:98:ALA:HB2	2.50	0.46
1:B:18:ILE:HG23	2:B:281:HOH:O	2.14	0.46
1:B:172:TYR:HE1	1:B:226:ARG:HG2	1.80	0.46
1:A:146:TYR:HB2	1:A:187:TRP:HH2	1.81	0.45
1:A:34:HIS:CE1	1:A:59:VAL:HG11	2.51	0.45
1:B:155:ILE:HG13	1:B:231:ILE:CD1	2.46	0.45
1:B:135:LEU:HD23	1:B:235:CYS:HB2	1.95	0.45
1:B:8:ARG:HA	1:B:14:ASN:HD22	1.82	0.45
1:B:20:ARG:HH22	1:B:91:GLU:CD	2.24	0.45
1:A:142:MET:HE3	1:A:187:TRP:CE2	2.52	0.44
1:B:43:ARG:HD2	1:B:150:PRO:O	2.17	0.44
1:B:111:THR:HG23	1:B:113:ASN:H	1.82	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:114:GLU:CB	1:B:117:GLU:HB2	2.48	0.44
1:A:52:TRP:CE3	1:A:53:PRO:HD3	2.53	0.44
1:A:189:ILE:HA	1:A:193:THR:O	2.18	0.44
1:B:24:ILE:HA	1:B:25:PRO:C	2.43	0.44
1:B:106:PHE:CD2	1:B:110:GLY:HA3	2.53	0.43
1:A:139:GLU:CD	1:A:139:GLU:N	2.77	0.43
1:A:155:ILE:HG12	1:A:229:LEU:HB3	2.00	0.43
1:A:4:SER:HB3	1:A:188:GLY:HA2	1.99	0.43
1:B:60:GLN:HE21	1:B:101:GLN:HE21	1.66	0.43
1:B:111:THR:CG2	1:B:113:ASN:HB2	2.49	0.43
1:B:219:TYR:HB3	1:B:224:GLY:CA	2.50	0.42
1:A:42:ASP:O	1:A:46:ILE:HG13	2.18	0.42
1:A:115:PHE:C	1:A:115:PHE:CD2	2.97	0.42
1:B:14:ASN:HD21	1:B:16:ALA:HB3	1.85	0.42
1:B:194:GLU:HG2	1:B:216:THR:CG2	2.50	0.42
1:B:52:TRP:HA	1:B:53:PRO:HA	1.85	0.42
1:B:60:GLN:NE2	1:B:101:GLN:HE21	2.17	0.42
1:B:95:ASN:O	1:B:97:GLN:HG3	2.20	0.42
1:A:229:LEU:O	1:A:230:ALA:HB3	2.20	0.41
1:A:156:MET:SD	1:A:176:THR:HA	2.60	0.41
1:B:167:GLY:N	1:B:208:GLU:OE2	2.52	0.41
1:A:138:ARG:HG2	1:A:138:ARG:NH1	2.35	0.41
1:B:108:GLN:O	1:B:109:CYS:HB2	2.20	0.41
1:B:204:GLU:OE2	1:B:209:ARG:NH1	2.54	0.41
1:A:21:ASN:HB2	1:A:203:GLY:CA	2.51	0.41
1:B:114:GLU:N	1:B:114:GLU:CD	2.78	0.41
1:B:155:ILE:HG13	1:B:231:ILE:HD12	2.04	0.40
1:A:30:SER:CB	1:A:63:ILE:HD11	2.51	0.40
1:B:168:ILE:CD1	1:B:190:SER:HB3	2.51	0.40
1:B:194:GLU:HG2	1:B:216:THR:HG21	2.03	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	240/242 (99%)	225 (94%)	15 (6%)	0	100	100
1	B	240/242 (99%)	214 (89%)	25 (10%)	1 (0%)	30	51
All	All	480/484 (99%)	439 (92%)	40 (8%)	1 (0%)	43	65

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	109	CYS

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	199/199 (100%)	171 (86%)	28 (14%)	3	7
1	B	199/199 (100%)	175 (88%)	24 (12%)	5	11
All	All	398/398 (100%)	346 (87%)	52 (13%)	4	9

All (52) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	LEU
1	A	8	ARG
1	A	24	ILE
1	A	31	CYS
1	A	43	ARG
1	A	49	LYS
1	A	55	THR
1	A	59	VAL
1	A	72	GLU
1	A	77	LEU
1	A	105	LYS
1	A	111	THR

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Mol	Chain	Res	Type
1	A	113	ASN
1	A	114	GLU
1	A	122	ARG
1	A	135	LEU
1	A	155	ILE
1	A	159	GLU
1	A	161	LEU
1	A	174	ASP
1	A	182	VAL
1	A	184	VAL
1	A	198	VAL
1	A	199	ARG
1	A	212	LEU
1	A	218	THR
1	A	229	LEU
1	A	242	VAL
1	B	1	LEU
1	B	4	SER
1	B	8	ARG
1	B	31	CYS
1	B	43	ARG
1	B	47	LYS
1	B	77	LEU
1	B	99	LYS
1	B	114	GLU
1	B	117	GLU
1	B	122	ARG
1	B	129	VAL
1	B	135	LEU
1	B	155	ILE
1	B	159	GLU
1	B	161	LEU
1	B	163	ASN
1	B	182	VAL
1	B	198	VAL
1	B	199	ARG
1	B	208	GLU
1	B	213	ARG
1	B	226	ARG
1	B	229	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	22	GLN
1	A	95	ASN
1	A	113	ASN
1	A	119	HIS
1	A	163	ASN
1	A	173	GLN
1	B	14	ASN
1	B	23	HIS
1	B	67	ASN
1	B	85	GLN
1	B	101	GLN
1	B	173	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](#)

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

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.