



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 12, 2026 – 05:20 PM UTC

PDB ID : 1A88 / pdb_00001a88
Title : CHLOROPEROXIDASE L
Authors : Hofmann, B.; Toelzer, S.; Pelletier, I.; Altenbuchner, J.; Van Pee, K.-H.; Hecht, H.-J.
Deposited on : 1998-04-03
Resolution : 1.90 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)	:	2.0
EDS	:	3.0
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

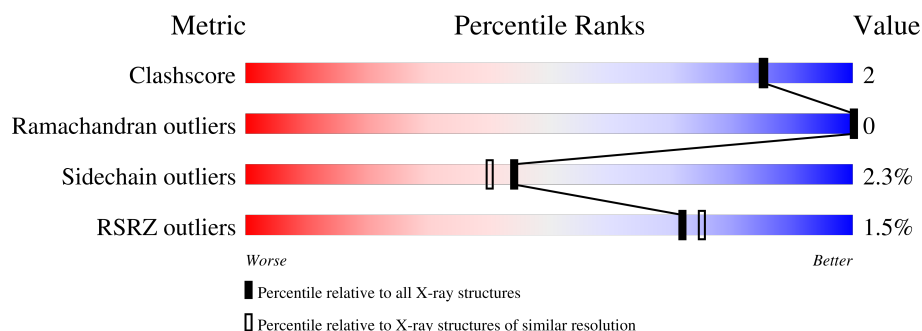
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.90 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	8410 (1.90-1.90)
Ramachandran outliers	187476	8333 (1.90-1.90)
Sidechain outliers	187428	8333 (1.90-1.90)
RSRZ outliers	180081	7790 (1.90-1.90)

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 $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	275	85% 13% .
1	B	275	3% 87% 12% .
1	C	275	90% 9% .

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 6822 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 CHLOROPEROXIDASE L.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	275	Total	C	N	O	S	0	0	0
			2105	1331	366	401	7			
1	B	275	Total	C	N	O	S	0	0	0
			2105	1331	366	401	7			
1	C	275	Total	C	N	O	S	0	0	0
			2105	1331	366	401	7			

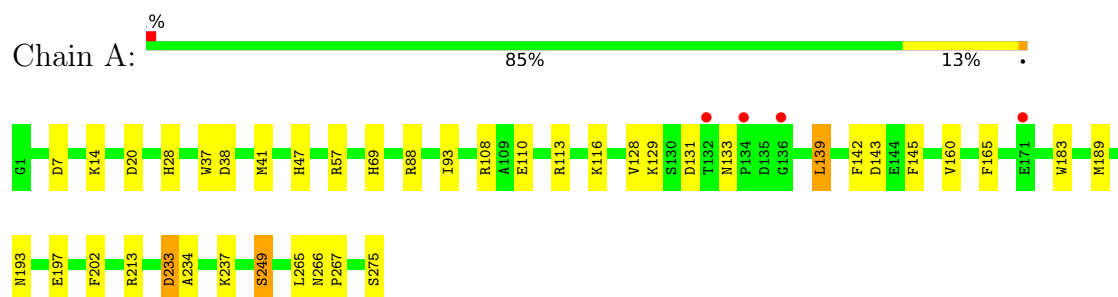
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	169	Total	O	0	0
			169	169		
2	B	154	Total	O	0	0
			154	154		
2	C	184	Total	O	0	0
			184	184		

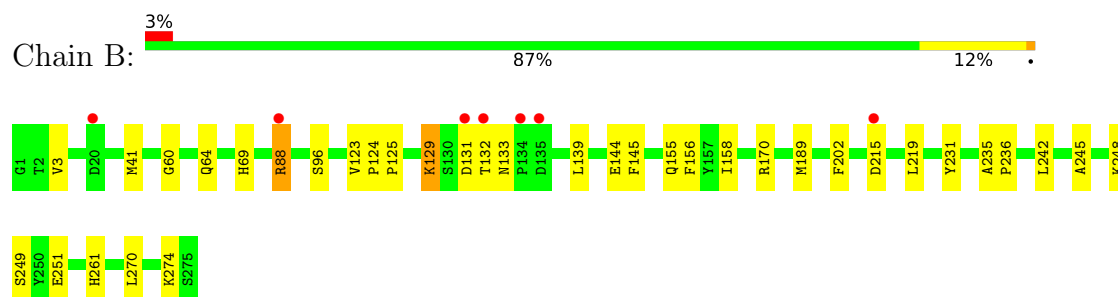
3 Residue-property plots

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 and electron density. 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. A red dot above a residue indicates a poor fit to the electron density ($RSRZ > 2$). 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.

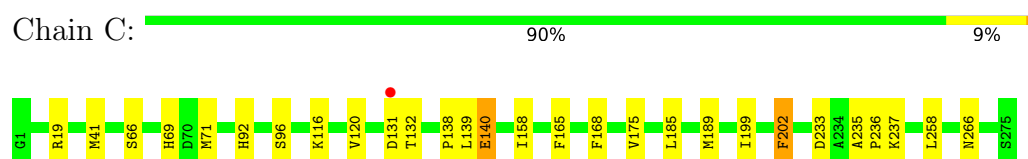
• Molecule 1: CHLOROPEROXIDASE L



• Molecule 1: CHLOROPEROXIDASE L



• Molecule 1: CHLOROPEROXIDASE L



4 Data and refinement statistics

Property	Value	Source
Space group	I 4	Depositor
Cell constants a, b, c, α , β , γ	176.50Å 176.50Å 64.00Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	130.00 – 1.90 124.80 – 1.90	Depositor EDS
% Data completeness (in resolution range)	84.7 (130.00-1.90) 84.7 (124.80-1.90)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.89 (at 1.89Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.160 , 0.193 0.146 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å ²)	16.7	Xtriage
Anisotropy	0.155	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 52.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.025 for -k,-h,-l	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	6822	wwPDB-VP
Average B, all atoms (Å ²)	22.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.43% 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

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	0.94	0/2165	1.63	31/2955 (1.0%)
1	B	0.85	1/2165 (0.0%)	1.51	18/2955 (0.6%)
1	C	0.98	0/2165	1.60	13/2955 (0.4%)
All	All	0.92	1/6495 (0.0%)	1.58	62/8865 (0.7%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	261	HIS	CA-CB	5.42	1.59	1.53

All (62) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	131	ASP	CA-CB-CG	11.40	124.00	112.60
1	A	88	ARG	CD-NE-CZ	10.43	139.00	124.40
1	B	202	PHE	CA-CB-CG	8.65	122.45	113.80
1	C	92	HIS	CA-CB-CG	-8.45	105.35	113.80
1	C	202	PHE	CA-CB-CG	7.98	121.78	113.80
1	B	88	ARG	CD-NE-CZ	7.68	135.15	124.40
1	C	41	MET	CA-CB-CG	-7.45	99.20	114.10
1	A	69	HIS	CA-CB-CG	-7.13	106.67	113.80
1	A	202	PHE	CA-CB-CG	7.02	120.82	113.80
1	A	233	ASP	CA-CB-CG	6.95	119.55	112.60
1	A	213	ARG	CD-NE-CZ	6.63	133.68	124.40
1	A	160	VAL	CA-C-O	6.35	122.95	118.69
1	B	41	MET	CA-CB-CG	-6.35	101.40	114.10
1	A	142	PHE	CA-CB-CG	-6.31	107.49	113.80
1	A	145	PHE	CA-CB-CG	6.14	119.94	113.80
1	C	158	ILE	N-CA-C	-6.12	105.10	111.58
1	A	265	LEU	N-CA-C	6.06	117.96	111.36
1	A	108	ARG	CD-NE-CZ	6.04	132.85	124.40
1	A	47	HIS	CA-CB-CG	-6.01	107.79	113.80
1	A	160	VAL	O-C-N	-6.00	116.58	120.42

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	20	ASP	CA-CB-CG	-5.97	106.63	112.60
1	A	93	ILE	CA-C-N	-5.90	117.64	121.65
1	A	93	ILE	C-N-CA	-5.90	117.64	121.65
1	C	69	HIS	CA-CB-CG	-5.84	107.96	113.80
1	C	266	ASN	OD1-CG-ND2	5.77	128.37	122.60
1	A	133	ASN	CA-C-N	5.76	125.38	119.56
1	A	133	ASN	C-N-CA	5.76	125.38	119.56
1	A	183	TRP	CA-C-O	5.63	126.73	120.82
1	A	234	ALA	CA-C-N	5.61	127.73	120.44
1	A	234	ALA	C-N-CA	5.61	127.73	120.44
1	A	28	HIS	CA-C-N	-5.55	116.78	122.27
1	A	28	HIS	C-N-CA	-5.55	116.78	122.27
1	B	170	ARG	NE-CZ-NH1	-5.54	115.96	121.50
1	C	19	ARG	NE-CZ-NH1	-5.53	115.97	121.50
1	A	41	MET	CA-CB-CG	-5.52	103.05	114.10
1	A	249	SER	CA-C-O	-5.52	114.36	120.38
1	C	71	MET	CA-C-O	5.44	126.25	120.10
1	A	143	ASP	CA-C-O	-5.40	114.69	120.42
1	A	108	ARG	NE-CZ-NH1	5.39	126.89	121.50
1	B	69	HIS	CA-CB-CG	-5.38	108.42	113.80
1	C	116	LYS	CA-C-O	-5.38	115.70	121.45
1	B	261	HIS	CA-CB-CG	-5.35	108.45	113.80
1	B	158	ILE	N-CA-C	-5.32	105.94	111.58
1	B	96	SER	N-CA-CB	-5.29	101.56	110.49
1	B	155	GLN	CA-C-N	5.29	127.36	120.28
1	B	155	GLN	C-N-CA	5.29	127.36	120.28
1	B	145	PHE	CA-CB-CG	5.28	119.08	113.80
1	B	156	PHE	CA-CB-CG	5.27	119.07	113.80
1	A	7	ASP	CA-CB-CG	5.26	117.86	112.60
1	A	165	PHE	N-CA-C	5.24	116.67	111.07
1	B	88	ARG	CG-CD-NE	5.22	123.48	112.00
1	B	123	VAL	N-CA-C	5.22	120.16	108.88
1	C	71	MET	O-C-N	-5.20	116.14	122.22
1	B	133	ASN	CA-C-N	5.14	124.80	119.56
1	B	133	ASN	C-N-CA	5.14	124.80	119.56
1	B	170	ARG	CA-C-O	5.05	126.44	120.69
1	C	96	SER	N-CA-CB	-5.03	101.98	110.49
1	C	66	SER	CA-CB-OG	-5.03	101.04	111.10
1	A	57	ARG	CD-NE-CZ	5.01	131.42	124.40
1	B	64	GLN	OE1-CD-NE2	-5.01	117.58	122.60
1	C	165	PHE	N-CA-C	5.01	116.43	111.07
1	A	14	LYS	CA-C-O	-5.01	115.50	121.16

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	2105	0	1998	9	0
1	B	2105	0	1998	9	0
1	C	2105	0	1998	9	0
2	A	169	0	0	0	0
2	B	154	0	0	1	0
2	C	184	0	0	0	0
All	All	6822	0	5994	27	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 2.

All (27) 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:C:233:ASP:HA	1:C:237:LYS:NZ	2.04	0.72
1:B:235:ALA:HB3	1:B:236:PRO:HD3	1.72	0.70
1:A:189:MET:HA	1:A:189:MET:HE2	1.80	0.64
1:C:233:ASP:HA	1:C:237:LYS:HZ3	1.63	0.63
1:A:128:VAL:HG21	1:A:139:LEU:HD23	1.81	0.62
1:B:129:LYS:HZ2	1:B:129:LYS:HB3	1.71	0.55
1:C:138:PRO:HB2	1:C:140:GLU:HG2	1.92	0.50
1:B:219:LEU:HD11	1:B:248:LYS:HG3	1.91	0.50
1:A:139:LEU:HD13	1:A:139:LEU:O	2.13	0.49
1:B:231:TYR:HH	1:B:249:SER:HG	1.61	0.48
1:B:270:LEU:HG	1:B:274:LYS:HD2	1.96	0.47
1:A:37:TRP:O	1:A:38:ASP:C	2.57	0.45
1:B:242:LEU:HB2	1:B:245:ALA:HB2	1.99	0.45
1:C:233:ASP:HA	1:C:237:LYS:HZ2	1.80	0.45
1:A:193:ASN:O	1:A:197:GLU:HG3	2.17	0.44
1:C:185:LEU:O	1:C:189:MET:HG2	2.17	0.44
1:C:235:ALA:HB3	1:C:236:PRO:HD3	2.00	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:110:GLU:HB2	1:A:113:ARG:HG3	2.00	0.43
1:B:124:PRO:HA	1:B:125:PRO:C	2.42	0.43
1:B:251:GLU:HG3	2:B:411:HOH:O	2.18	0.43
1:B:60:GLY:HA2	1:B:189:MET:HE3	2.01	0.42
1:A:233:ASP:HA	1:A:237:LYS:HD2	2.00	0.42
1:A:116:LYS:NZ	1:A:275:SER:OG	2.52	0.42
1:A:266:ASN:N	1:A:267:PRO:CD	2.84	0.41
1:C:120:VAL:HG11	1:C:258:LEU:HD11	2.02	0.41
1:C:199:ILE:HA	1:C:202:PHE:CE2	2.57	0.40
1:C:168:PHE:HB3	1:C:175:VAL:HG22	2.03	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 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	273/275 (99%)	263 (96%)	10 (4%)	0	100	100
1	B	273/275 (99%)	260 (95%)	13 (5%)	0	100	100
1	C	273/275 (99%)	262 (96%)	11 (4%)	0	100	100
All	All	819/825 (99%)	785 (96%)	34 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	217/217 (100%)	214 (99%)	3 (1%)	59	59
1	B	217/217 (100%)	209 (96%)	8 (4%)	30	22
1	C	217/217 (100%)	213 (98%)	4 (2%)	51	50
All	All	651/651 (100%)	636 (98%)	15 (2%)	44	40

All (15) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	129	LYS
1	A	139	LEU
1	A	249	SER
1	B	3	VAL
1	B	88	ARG
1	B	129	LYS
1	B	131	ASP
1	B	132	THR
1	B	139	LEU
1	B	144	GLU
1	B	215	ASP
1	C	131	ASP
1	C	132	THR
1	C	139	LEU
1	C	140	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	177	GLN
1	B	47	HIS
1	C	10	ASN
1	C	186	GLN

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 [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 [i](#)

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

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	A	275/275 (100%)	-0.39	4 (1%) 72 75	8, 18, 38, 52	0
1	B	275/275 (100%)	-0.17	7 (2%) 58 62	10, 23, 44, 60	0
1	C	275/275 (100%)	-0.41	1 (0%) 88 90	8, 18, 38, 59	0
All	All	825/825 (100%)	-0.32	12 (1%) 72 75	8, 19, 40, 60	0

All (12) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	131	ASP	3.3
1	B	131	ASP	2.9
1	A	134	PRO	2.7
1	B	215	ASP	2.6
1	B	132	THR	2.6
1	B	88	ARG	2.4
1	A	136	GLY	2.4
1	B	135	ASP	2.3
1	A	132	THR	2.3
1	B	134	PRO	2.3
1	A	171	GLU	2.2
1	B	20	ASP	2.2

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

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

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.