



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 12:12 AM UTC

PDB ID : 4TXD / pdb_00004txd
Title : Crystal structure of Thermophilum pendens Csc2
Authors : Hrle, A.; Conti, E.
Deposited on : 2014-07-03
Resolution : 1.82 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

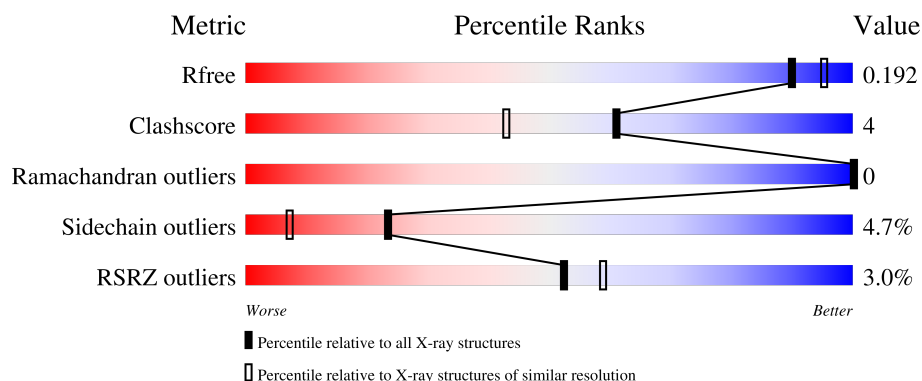
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.82 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))
R_{free}	180053	1112 (1.82-1.82)
Clashscore	190562	1148 (1.82-1.82)
Ramachandran outliers	187476	1140 (1.82-1.82)
Sidechain outliers	187428	1140 (1.82-1.82)
RSRZ outliers	180081	1112 (1.82-1.82)

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	390	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3200 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 Csc2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	336	2706	1720	472	504	10	0	12	0

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-15	HIS	-	expression tag	UNP A1RZU2
A	-14	HIS	-	expression tag	UNP A1RZU2
A	-13	HIS	-	expression tag	UNP A1RZU2
A	-12	HIS	-	expression tag	UNP A1RZU2
A	-11	HIS	-	expression tag	UNP A1RZU2
A	-10	HIS	-	expression tag	UNP A1RZU2
A	-9	SER	-	expression tag	UNP A1RZU2
A	-8	SER	-	expression tag	UNP A1RZU2
A	-7	GLY	-	expression tag	UNP A1RZU2
A	-6	LEU	-	expression tag	UNP A1RZU2
A	-5	VAL	-	expression tag	UNP A1RZU2
A	-4	PRO	-	expression tag	UNP A1RZU2
A	-3	ARG	-	expression tag	UNP A1RZU2
A	-2	GLY	-	expression tag	UNP A1RZU2
A	-1	SER	-	expression tag	UNP A1RZU2
A	0	HIS	-	expression tag	UNP A1RZU2

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

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

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	493	Total 493	O 493	0	0

- Molecule 1: Csc2



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	80.95Å 112.59Å 60.47Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	46.22 – 1.82 46.22 – 1.82	Depositor EDS
% Data completeness (in resolution range)	99.4 (46.22-1.82) 99.8 (46.22-1.82)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.56 (at 1.82Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.9_1678)	Depositor
R, R_{free}	0.181 , 0.212 (Not available) , 0.192	Depositor DCC
R_{free} test set	2521 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å ²)	28.2	Xtriage
Anisotropy	0.208	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 41.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	3200	wwPDB-VP
Average B, all atoms (Å ²)	35.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.86% 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

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	1.27	31/2780 (1.1%)	0.91	12/3747 (0.3%)

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	2

All (31) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	50[A]	LEU	C-N	-11.23	1.17	1.33
1	A	50[B]	LEU	C-N	-11.23	1.17	1.33
1	A	209[A]	THR	CA-C	10.70	1.67	1.52
1	A	209[B]	THR	CA-C	10.70	1.67	1.52
1	A	47[A]	ASN	C-N	-8.64	1.22	1.33
1	A	47[B]	ASN	C-N	-8.64	1.22	1.33
1	A	340[A]	GLU	CA-C	8.21	1.63	1.52
1	A	340[B]	GLU	CA-C	8.21	1.63	1.52
1	A	258	ILE	C-O	-7.21	1.16	1.24
1	A	217	VAL	C-O	-6.59	1.17	1.24
1	A	49	LEU	C-N	-6.27	1.24	1.33
1	A	216	GLU	C-O	-5.91	1.17	1.23
1	A	294	VAL	C-O	-5.73	1.17	1.24
1	A	259[A]	TYR	CA-C	5.72	1.59	1.52
1	A	259[B]	TYR	CA-C	5.72	1.59	1.52
1	A	208	MET	C-O	-5.69	1.17	1.23
1	A	236	GLU	C-O	-5.49	1.19	1.24
1	A	280	TYR	C-O	-5.41	1.17	1.24

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	283	ALA	C-O	-5.41	1.17	1.24
1	A	153	PRO	N-CD	5.39	1.55	1.47
1	A	151	PHE	C-O	-5.37	1.17	1.23
1	A	51	LEU	C-O	-5.35	1.17	1.24
1	A	19	PRO	N-CD	5.32	1.55	1.47
1	A	154	HIS	C-O	-5.28	1.17	1.24
1	A	342	MET	C-O	-5.26	1.18	1.24
1	A	296	LYS	C-O	-5.21	1.18	1.24
1	A	33	LYS	C-O	-5.09	1.17	1.23
1	A	153	PRO	C-O	-5.05	1.17	1.24
1	A	18	ARG	C-N	5.05	1.40	1.33
1	A	86	ARG	C-O	-5.05	1.18	1.24
1	A	106	ARG	C-O	-5.04	1.18	1.24

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	259[A]	TYR	N-CA-C	7.82	121.25	108.26
1	A	259[B]	TYR	N-CA-C	7.82	121.25	108.26
1	A	340[A]	GLU	N-CA-C	6.66	119.39	111.33
1	A	340[B]	GLU	N-CA-C	6.66	119.39	111.33
1	A	209[A]	THR	CA-C-O	-6.39	114.07	121.49
1	A	209[B]	THR	CA-C-O	-6.39	114.07	121.49
1	A	18	ARG	CA-C-N	-5.87	113.58	119.56
1	A	18	ARG	C-N-CA	-5.87	113.58	119.56
1	A	14	LEU	N-CA-C	5.45	118.94	112.72
1	A	209[A]	THR	N-CA-C	5.45	116.91	109.18
1	A	209[B]	THR	N-CA-C	5.45	116.91	109.18
1	A	198	HIS	N-CA-C	5.14	118.86	112.59

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	259[A]	TYR	Mainchain
1	A	259[B]	TYR	Mainchain

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	2706	0	2749	23	0
2	A	1	0	0	0	0
3	A	493	0	0	8	5
All	All	3200	0	2749	23	5

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 4.

All (23) 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:50[A]:LEU:HD21	1:A:52:ARG:NH2	1.77	1.00
1:A:131:THR:OG1	1:A:133:GLN:HG2	1.79	0.82
1:A:71:MET:SD	3:A:562:HOH:O	2.39	0.80
1:A:50[A]:LEU:HD21	1:A:52:ARG:HH21	1.44	0.78
1:A:18:ARG:HG3	3:A:993:HOH:O	1.94	0.66
1:A:340[A]:GLU:OE1	3:A:856:HOH:O	2.15	0.65
1:A:18:ARG:NH2	3:A:993:HOH:O	1.87	0.63
1:A:199:ASN:O	1:A:209[B]:THR:HG23	2.03	0.58
1:A:340[B]:GLU:OE1	1:A:341:LYS:HD2	2.06	0.55
1:A:131:THR:OG1	1:A:132:ILE:N	2.41	0.51
1:A:209[B]:THR:HG22	1:A:210:GLY:H	1.77	0.49
1:A:340[A]:GLU:CD	3:A:856:HOH:O	2.56	0.48
1:A:209[B]:THR:HG21	3:A:837:HOH:O	2.12	0.48
1:A:344:LYS:HE3	1:A:348:GLU:OE2	2.13	0.47
1:A:50[B]:LEU:HD22	1:A:218:HIS:CD2	2.51	0.45
1:A:226:ILE:HD12	1:A:283:ALA:HA	1.98	0.44
1:A:86:ARG:HD3	1:A:154:HIS:ND1	2.32	0.44
1:A:197:THR:HG23	3:A:575:HOH:O	2.17	0.43
1:A:178[B]:LYS:HD2	3:A:889:HOH:O	2.17	0.42
1:A:119:LEU:HD21	1:A:340[B]:GLU:HG2	2.00	0.42
1:A:209[B]:THR:HG22	1:A:210:GLY:N	2.36	0.41
1:A:311:ASP:OD2	1:A:313[A]:SER:OG	2.28	0.40
1:A:231:LEU:HD23	1:A:239:LEU:HD12	2.03	0.40

All (5) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:A:534:HOH:O	3:A:571:HOH:O[4_578]	1.97	0.23
3:A:501:HOH:O	3:A:594:HOH:O[4_478]	2.12	0.08
3:A:603:HOH:O	3:A:611:HOH:O[4_478]	2.14	0.06
3:A:580:HOH:O	3:A:597:HOH:O[4_578]	2.18	0.02
3:A:576:HOH:O	3:A:595:HOH:O[4_577]	2.19	0.01

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	344/390 (88%)	334 (97%)	10 (3%)	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	289/324 (89%)	275 (95%)	14 (5%)	23	6

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	54	GLU
1	A	65	GLU
1	A	72	GLU
1	A	86	ARG

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Mol	Chain	Res	Type
1	A	102	GLU
1	A	106	ARG
1	A	133	GLN
1	A	154	HIS
1	A	182[A]	ARG
1	A	182[B]	ARG
1	A	197	THR
1	A	239	LEU
1	A	246	LEU
1	A	256	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	35	HIS
1	A	198	HIS
1	A	297	ASN

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 1 ligands modelled in this entry, 1 is 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

There are no such residues in this entry.

5.8 Polymer linkage issues

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	A	2

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	A	50[A]:LEU	C	51:LEU	N	1.17
1	A	50[B]:LEU	C	51:LEU	N	1.17

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	336/390 (86%)	0.03	10 (2%) 52 59	12, 29, 52, 100	12 (3%)

All (10) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	255	ARG	6.9
1	A	5	LYS	3.7
1	A	13	GLY	3.6
1	A	133	GLN	3.3
1	A	198	HIS	3.1
1	A	131	THR	3.1
1	A	132	ILE	2.9
1	A	67	SER	2.2
1	A	197	THR	2.1
1	A	147	GLY	2.0

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](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q< 0.9’ lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	ZN	A	401	1/1	1.00	0.02	27,27,27,27	1

6.5 Other polymers [i](#)

There are no such residues in this entry.