



# wwPDB X-ray Structure Validation Summary Report ⓘ

Nov 12, 2024 – 06:51 PM EST

PDB ID : 3UJP  
Title : Structure of MntC protein at 2.7Å  
Authors : Kanteev, M.; Adir, N.  
Deposited on : 2011-11-08  
Resolution : 2.70 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto: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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.003 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.39

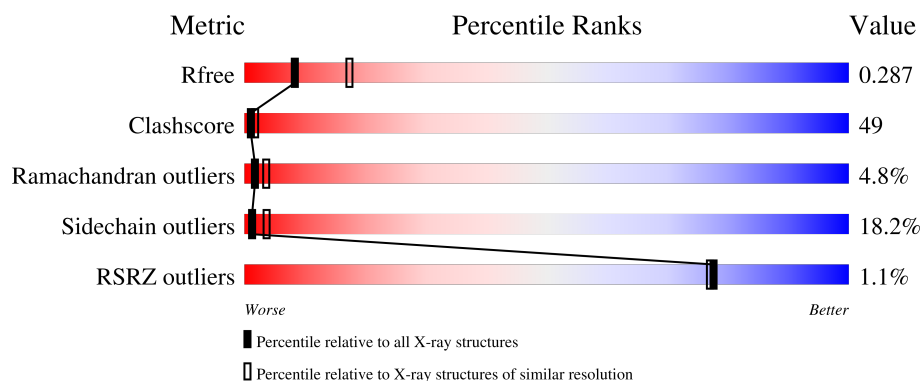
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.70 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))
$R_{free}$	164625	3333 (2.70-2.70)
Clashscore	180529	3684 (2.70-2.70)
Ramachandran outliers	177936	3633 (2.70-2.70)
Sidechain outliers	177891	3633 (2.70-2.70)
RSRZ outliers	164620	3333 (2.70-2.70)

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  $\geq 3$ , 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	307	
1	B	307	
1	C	307	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	CAC	A	2327	-	X	-	-

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 6424 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 Mn transporter subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	274	Total	C	N	O	S	0	0	0
			2149	1365	352	425	7			
1	B	267	Total	C	N	O	S	0	0	0
			2097	1333	345	412	7			
1	C	272	Total	C	N	O	S	0	0	0
			2137	1358	350	422	7			

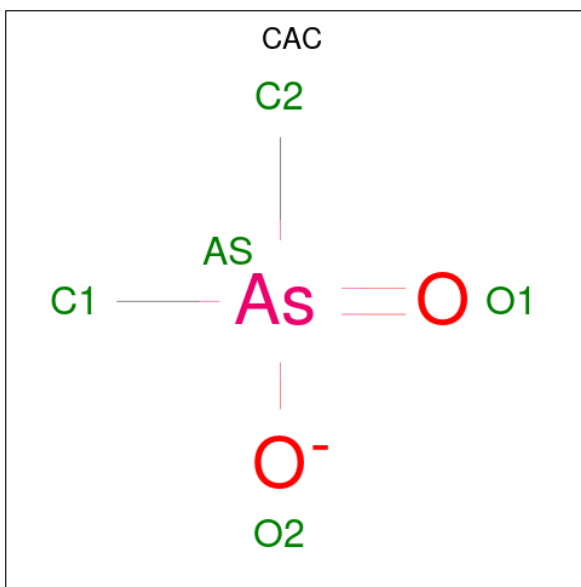
- Molecule 2 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Mn	0	0
			1	1		
2	B	1	Total	Mn	0	0
			1	1		
2	C	1	Total	Mn	0	0
			1	1		

- Molecule 3 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	4	Total	Zn	0	0
			4	4		
3	C	2	Total	Zn	0	0
			2	2		

- Molecule 4 is CACODYLATE ION (three-letter code: CAC) (formula: C<sub>2</sub>H<sub>6</sub>AsO<sub>2</sub>).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	A	1	Total	As	C	O	0	0
			5	1	2	2		
4	A	1	Total	As	C	O	0	0
			5	1	2	2		
4	C	1	Total	As	C	O	0	0
			5	1	2	2		
4	C	1	Total	As	C	O	0	0
			5	1	2	2		

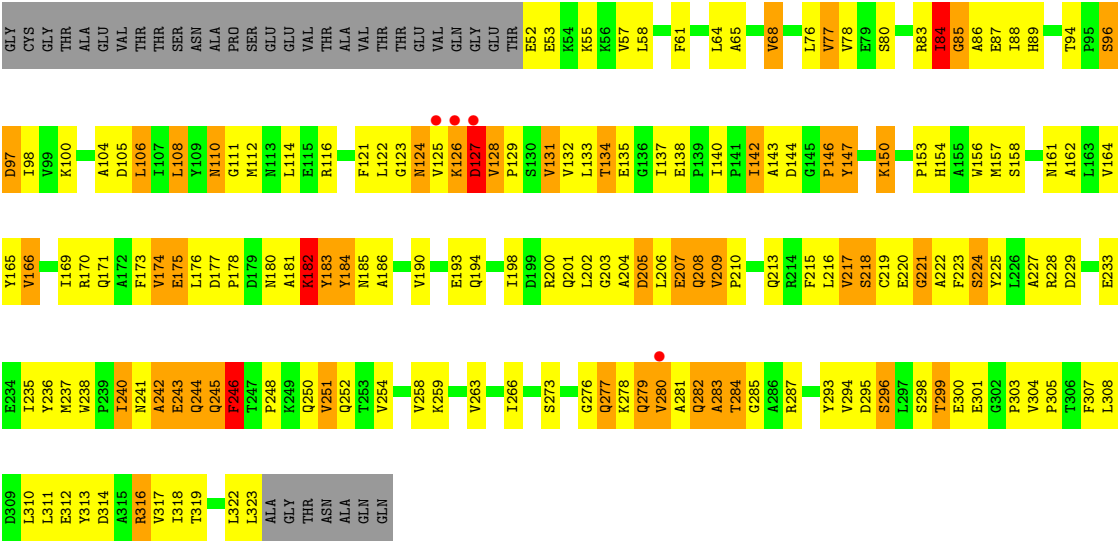
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	6	Total	O	0	0
			6	6		
5	B	5	Total	O	0	0
			5	5		
5	C	1	Total	O	0	0
			1	1		





● Molecule 1: Mn transporter subunit



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	127.52Å 127.52Å 89.73Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	36.80 – 2.70 36.80 – 2.70	Depositor EDS
% Data completeness (in resolution range)	92.0 (36.80-2.70) 91.9 (36.80-2.70)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.28 (at 2.69Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.6.1_357)	Depositor
R, $R_{free}$	0.231 , 0.284 0.239 , 0.287	Depositor DCC
$R_{free}$ test set	1089 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	83.7	Xtriage
Anisotropy	0.194	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 60.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.037 for -h,-k,l	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	6424	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	88.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.57% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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 [i](#)

### 5.1 Standard geometry [i](#)

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

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	0.60	0/2194	0.74	0/2991
1	B	0.66	1/2139 (0.0%)	0.73	0/2913
1	C	0.56	0/2182	0.67	0/2974
All	All	0.61	1/6515 (0.0%)	0.71	0/8878

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	123	GLY	C-N	-5.13	1.22	1.34

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts [i](#)

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	2149	0	2097	164	0
1	B	2097	0	2055	242	0
1	C	2137	0	2087	231	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
3	A	4	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	C	2	0	0	0	0
4	A	10	0	0	4	0
4	C	10	0	0	0	0
5	A	6	0	0	0	0
5	B	5	0	0	2	0
5	C	1	0	0	0	0
All	All	6424	0	6239	622	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 49.

The worst 5 of 622 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:B:213:GLN:HA	1:B:215:PHE:CE1	1.42	1.52
1:B:213:GLN:CA	1:B:215:PHE:HE1	1.44	1.28
1:B:258:VAL:HG22	1:B:263:VAL:CG2	1.68	1.22
1:B:265:THR:HB	1:B:321:GLY:O	1.41	1.20
1:C:89:HIS:CD2	1:C:295:ASP:OD2	1.98	1.17

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	272/307 (89%)	233 (86%)	33 (12%)	6 (2%)	5	15
1	B	263/307 (86%)	222 (84%)	31 (12%)	10 (4%)	2	6
1	C	270/307 (88%)	215 (80%)	32 (12%)	23 (8%)	0	1
All	All	805/921 (87%)	670 (83%)	96 (12%)	39 (5%)	2	3

5 of 39 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	84	ILE
1	A	85	GLY
1	A	154	HIS
1	A	243	GLU
1	A	245	GLN

### 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	234/259 (90%)	195 (83%)	39 (17%)	2	5
1	B	229/259 (88%)	181 (79%)	48 (21%)	1	2
1	C	233/259 (90%)	193 (83%)	40 (17%)	1	4
All	All	696/777 (90%)	569 (82%)	127 (18%)	1	4

5 of 127 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	157	MET
1	C	208	GLN
1	B	240	ILE
1	C	207	GLU
1	C	246	PHE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 19 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	180	ASN
1	C	213	GLN
1	C	277	GLN
1	C	201	GLN
1	B	185	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 13 ligands modelled in this entry, 9 are monoatomic - leaving 4 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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  $|Z| > 2$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z  > 2$	Counts	RMSZ	$\# Z  > 2$
4	CAC	C	2327	-	2,4,4	3.89	2 (100%)	2,6,6	0.75	0
4	CAC	C	332	-	2,4,4	4.77	2 (100%)	2,6,6	2.93	1 (50%)
4	CAC	A	2327	-	2,4,4	5.14	2 (100%)	2,6,6	2.25	2 (100%)
4	CAC	A	332	-	2,4,4	3.79	2 (100%)	2,6,6	2.08	1 (50%)

The worst 5 of 8 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	2327	CAC	AS-C2	-5.68	1.48	1.90
4	C	332	CAC	AS-C2	-5.47	1.50	1.90
4	A	2327	CAC	AS-C1	-4.54	1.57	1.90
4	C	2327	CAC	AS-C2	-4.04	1.60	1.90
4	C	332	CAC	AS-C1	-3.94	1.61	1.90

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	C	332	CAC	O1-AS-C1	-4.01	90.30	109.44
4	A	2327	CAC	O1-AS-C2	2.47	121.25	109.44
4	A	332	CAC	O1-AS-C1	2.42	120.97	109.44
4	A	2327	CAC	O1-AS-C1	-2.01	99.86	109.44

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	2327	CAC	1	0
4	A	332	CAC	3	0

## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	274/307 (89%)	-0.36	3 (1%) 77 77	59, 77, 102, 116	0
1	B	267/307 (86%)	-0.20	2 (0%) 84 83	54, 83, 120, 131	0
1	C	272/307 (88%)	-0.09	4 (1%) 71 71	24, 95, 136, 162	0
All	All	813/921 (88%)	-0.22	9 (1%) 77 77	24, 83, 129, 162	0

The worst 5 of 9 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	126	LYS	3.8
1	A	244	GLN	3.0
1	C	127	ASP	2.9
1	B	128	VAL	2.8
1	C	125	VAL	2.5

### 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 monosaccharides 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, 95<sup>th</sup> 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
3	ZN	A	3	1/1	0.58	0.09	110,110,110,110	1
3	ZN	C	331	1/1	0.64	0.23	133,133,133,133	0
4	CAC	A	332	5/5	0.72	0.15	68,83,91,114	1
4	CAC	A	2327	5/5	0.76	0.09	133,134,149,199	0
4	CAC	C	2327	5/5	0.80	0.10	98,102,111,143	1
4	CAC	C	332	5/5	0.80	0.09	127,139,141,166	1
3	ZN	A	5	1/1	0.87	0.06	142,142,142,142	0
3	ZN	A	2	1/1	0.91	0.07	88,88,88,88	1
3	ZN	A	331	1/1	0.92	0.08	113,113,113,113	0
3	ZN	C	4	1/1	0.94	0.20	111,111,111,111	0
2	MN	A	1	1/1	0.99	0.07	56,56,56,56	0
2	MN	C	1	1/1	0.99	0.05	85,85,85,85	0
2	MN	B	1	1/1	1.00	0.04	64,64,64,64	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.