wwPDB X-ray Structure Validation Summary Report (i)

Feb 1, 2016 – 04:23 AM GMT

PDB ID	:	2MIN
Title	:	NITROGENASE MOFE PROTEIN FROM AZOTOBACTER VINELANDII, OXIDIZED STATE
Authors	:	Peters, J.W.; Stowell, M.H.B.; Soltis, S.M.; Day, M.W.; Kim, J.; Rees, D.C.
Deposited on	:	1996-12-20
Resolution	:	2.03 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
A user guide is available at
http://wwpdb.org/validation/2016/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

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

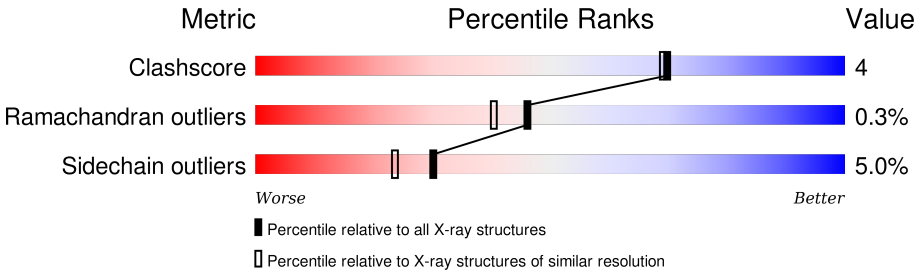
MolProbity	:	4.02b-467
Mogul	:	1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	trunk26865

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.03 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	102246	9060 (2.04-2.00)
Ramachandran outliers	100387	8952 (2.04-2.00)
Sidechain outliers	100360	8951 (2.04-2.00)

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 on the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria. 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 <=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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	491	75% 16% • 5%
1	C	491	75% 17% • • 5%
2	B	522	83% 14% •
2	D	522	84% 14% •

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
6	CFM	C	496	-	-	X	-

2 Entry composition (i)

There are 7 unique types of molecules in this entry. The entry contains 16491 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 NITROGENASE MOLYBDENUM IRON PROTEIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	467	Total	C	N	O	S	0	0	0
			3709	2361	630	694	24			
1	C	468	Total	C	N	O	S	0	0	0
			3713	2364	631	694	24			

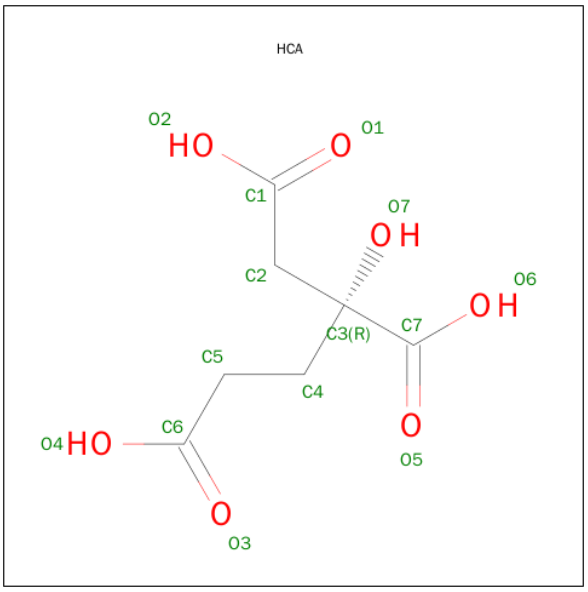
- Molecule 2 is a protein called NITROGENASE MOLYBDENUM IRON PROTEIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	522	Total	C	N	O	S	0	0	0
			4174	2666	705	775	28			
2	D	522	Total	C	N	O	S	0	0	0
			4174	2666	705	775	28			

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

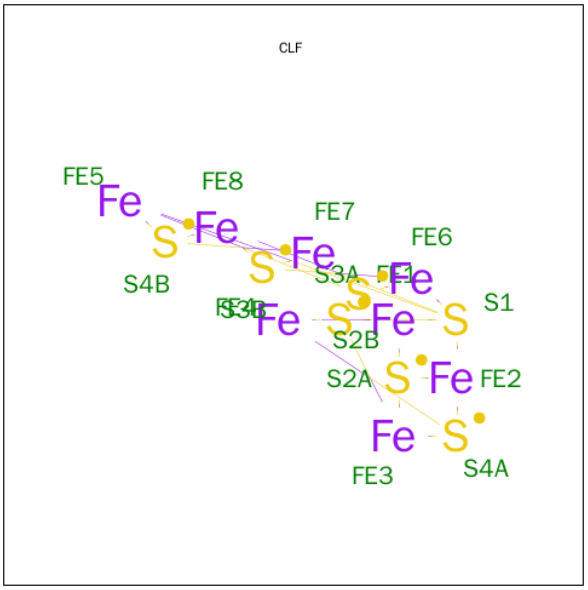
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	2	Total	Ca	0	0
			2	2		

- Molecule 4 is 3-HYDROXY-3-CARBOXY-ADIPIC ACID (three-letter code: HCA) (formula: $C_7H_{10}O_7$).



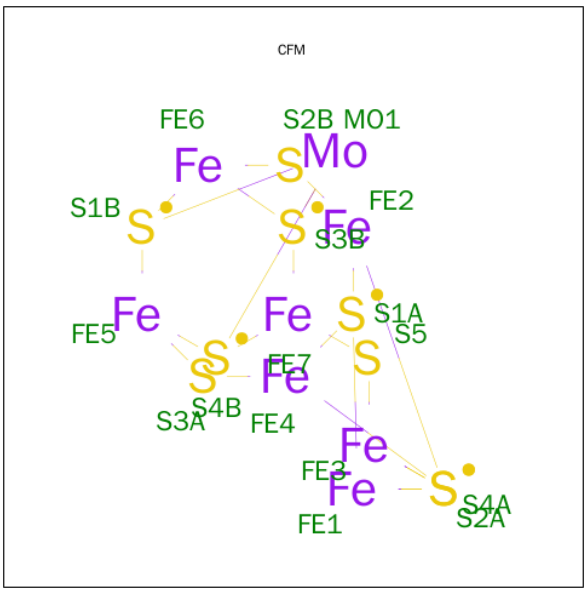
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total C O 14 7 7	0	0
4	C	1	Total C O 14 7 7	0	0

- Molecule 5 is FE(8)-S(7) CLUSTER (three-letter code: CLF) (formula: Fe_8S_7).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total Fe S 15 8 7	0	0
5	C	1	Total Fe S 15 8 7	0	0

- Molecule 6 is FE-MO-S CLUSTER (three-letter code: CFM) (formula: Fe_7MoS_9).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
6	A	1	Total	Fe	Mo	S	0	0
			17	7	1	9		
6	C	1	Total	Fe	Mo	S	0	0
			17	7	1	9		

- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	132	Total	O	0	0
			132	132		
7	B	186	Total	O	0	0
			186	186		
7	C	126	Total	O	0	0
			126	126		
7	D	183	Total	O	0	0
			183	183		

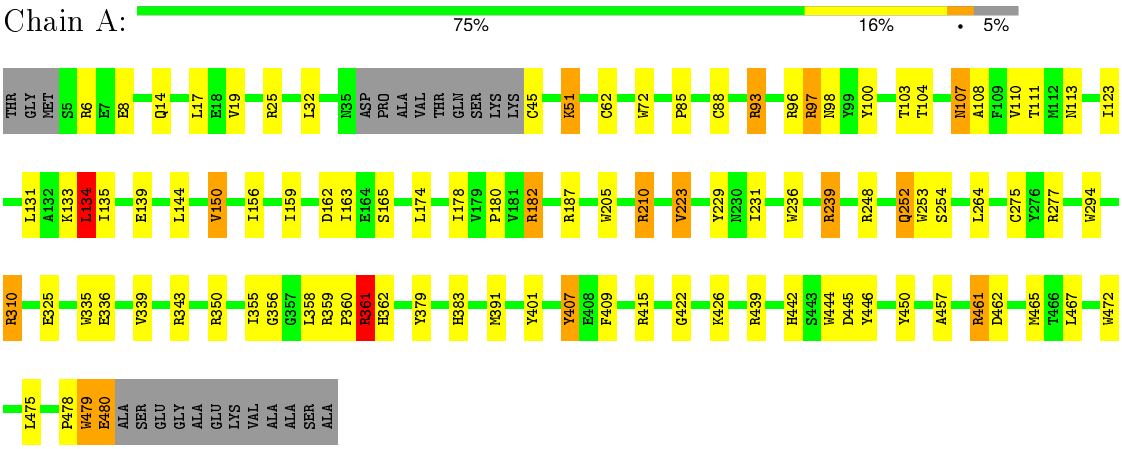
3 Residue-property plots (i)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

Note EDS was not executed.

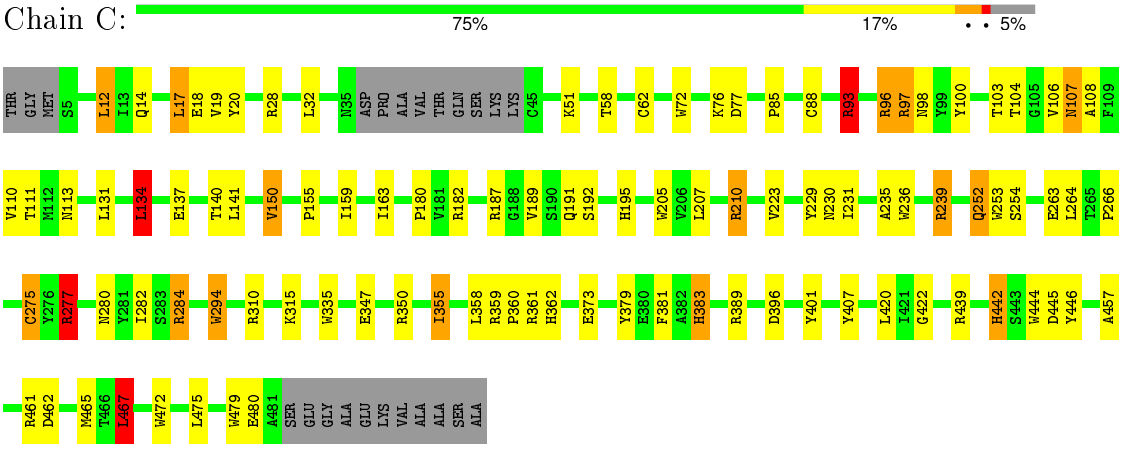
• Molecule 1: NITROGENASE MOLYBDENUM IRON PROTEIN

Chain A:



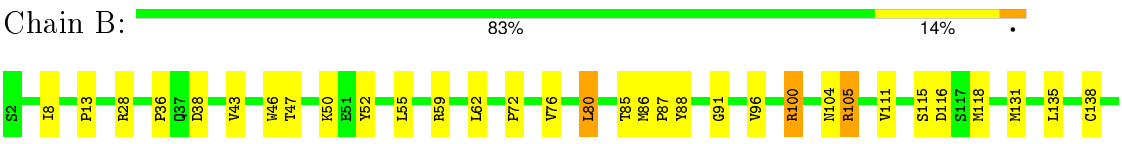
• Molecule 1: NITROGENASE MOLYBDENUM IRON PROTEIN

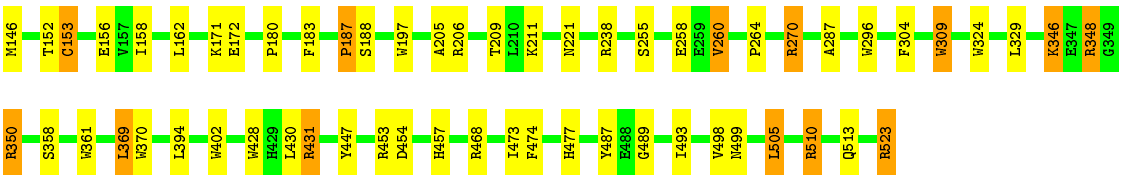
Chain C:



• Molecule 2: NITROGENASE MOLYBDENUM IRON PROTEIN

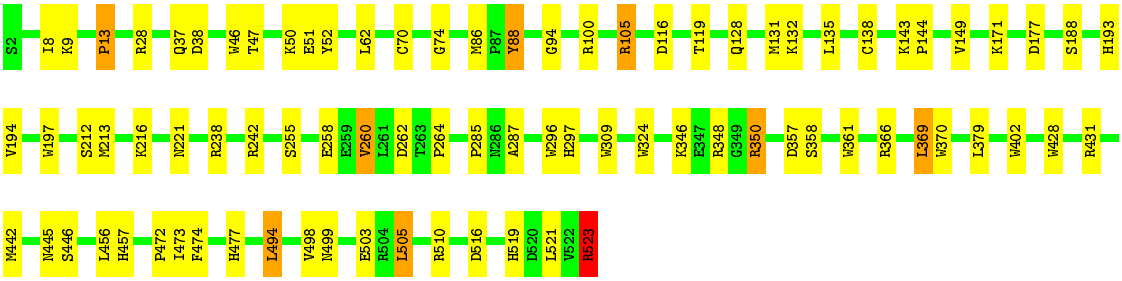
Chain B:





- Molecule 2: NITROGENASE MOLYBDENUM IRON PROTEIN

Chain D:



4 Data and refinement statistics (i)

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

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	107.70Å 130.20Å 81.30Å 90.00° 110.80° 90.00°	Depositor
Resolution (Å)	30.00 – 2.03	Depositor
% Data completeness (in resolution range)	91.6 (30.00-2.03)	Depositor
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR 3.0	Depositor
R, R_{free}	0.212 , 0.266	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	16491	wwPDB-VP
Average B, all atoms (Å^2)	24.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

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

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	0.75	2/3795 (0.1%)	1.46	61/5117 (1.2%)
1	C	0.76	3/3799 (0.1%)	1.43	61/5123 (1.2%)
2	B	0.76	2/4280 (0.0%)	1.35	56/5786 (1.0%)
2	D	0.76	2/4280 (0.0%)	1.33	51/5786 (0.9%)
All	All	0.76	9/16154 (0.1%)	1.39	229/21812 (1.0%)

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	1
1	C	0	1
All	All	0	2

The worst 5 of 9 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	188	SER	CB-OG	-14.21	1.23	1.42
2	B	188	SER	CB-OG	-10.66	1.28	1.42
1	A	88	CYS	CB-SG	-7.35	1.69	1.82
2	D	70	CYS	CB-SG	-6.43	1.71	1.82
2	B	153	CYS	CB-SG	-6.40	1.71	1.82

The worst 5 of 229 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	210	ARG	NE-CZ-NH1	11.93	126.26	120.30
2	D	431	ARG	NE-CZ-NH2	-11.88	114.36	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	523	ARG	NE-CZ-NH1	11.68	126.14	120.30
2	B	431	ARG	NE-CZ-NH1	11.64	126.12	120.30
2	D	431	ARG	NE-CZ-NH1	11.54	126.07	120.30

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	446	TYR	Sidechain
1	C	446	TYR	Sidechain

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	3709	0	3636	38	0
1	C	3713	0	3638	43	0
2	B	4174	0	4087	42	0
2	D	4174	0	4087	34	0
3	B	2	0	0	0	0
4	A	14	0	6	0	0
4	C	14	0	6	1	0
5	A	15	0	0	1	0
5	C	15	0	0	1	0
6	A	17	0	0	1	0
6	C	17	0	0	5	0
7	A	132	0	0	2	0
7	B	186	0	0	3	0
7	C	126	0	0	3	0
7	D	183	0	0	1	0
All	All	16491	0	15460	141	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 4.

The worst 5 of 141 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)
2:B:209:THR:HG21	2:B:309:TRP:HE1	1.37	0.87
2:B:85:THR:HG22	2:B:146:MET:HB3	1.63	0.80
2:B:346:LYS:HE3	2:D:264:PRO:HG3	1.67	0.75
2:B:499:ASN:HD21	2:D:477:HIS:H	1.38	0.72
2:B:209:THR:HG21	2:B:309:TRP:NE1	2.03	0.72

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	463/491 (94%)	439 (95%)	22 (5%)	2 (0%)	39	32
1	C	464/491 (94%)	441 (95%)	21 (4%)	2 (0%)	39	32
2	B	520/522 (100%)	508 (98%)	11 (2%)	1 (0%)	52	47
2	D	520/522 (100%)	507 (98%)	12 (2%)	1 (0%)	52	47
All	All	1967/2026 (97%)	1895 (96%)	66 (3%)	6 (0%)	46	40

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	6	ARG
2	D	255	SER
2	B	255	SER
1	C	254	SER
1	A	478	PRO

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	397/414 (96%)	371 (94%)	26 (6%)	21	14
1	C	396/414 (96%)	369 (93%)	27 (7%)	20	13
2	B	454/454 (100%)	438 (96%)	16 (4%)	43	40
2	D	454/454 (100%)	438 (96%)	16 (4%)	43	40
All	All	1701/1736 (98%)	1616 (95%)	85 (5%)	30	24

5 of 85 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	329	LEU
1	C	93	ARG
2	D	260	VAL
2	B	346	LYS
1	C	14	GLN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 31 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	252	GLN
1	C	383	HIS
2	D	513	GLN
1	C	271	ASN
2	D	37	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 carbohydrates in this entry.

5.6 Ligand geometry (i)

Of 8 ligands modelled in this entry, 2 are monoatomic - leaving 6 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	HCA	A	494	6	4,13,13	2.24	2 (50%)	3,18,18	1.92	1 (33%)
6	CFM	A	496	1,4	0,24,24	0.00	-	0,45,45	0.00	-
5	CLF	A	498	1,2	0,24,24	0.00	-	0,57,57	0.00	-
4	HCA	C	494	6	4,13,13	1.65	1 (25%)	3,18,18	2.57	1 (33%)
6	CFM	C	496	1,4	0,24,24	0.00	-	0,45,45	0.00	-
5	CLF	C	498	1,2	0,24,24	0.00	-	0,57,57	0.00	-

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the chemical component dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
4	HCA	A	494	6	-	0/7/17/17	0/0/0/0
6	CFM	A	496	1,4	-	0/0/84/84	0/0/8/8
5	CLF	A	498	1,2	-	0/0/132/132	0/12/10/10
4	HCA	C	494	6	-	0/7/17/17	0/0/0/0
6	CFM	C	496	1,4	-	0/0/84/84	0/0/8/8
5	CLF	C	498	1,2	-	0/0/132/132	0/12/10/10

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	494	HCA	C2-C3	-3.15	1.49	1.54
4	A	494	HCA	C4-C3	2.74	1.57	1.53
4	C	494	HCA	O7-C3	2.74	1.47	1.43

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	A	494	HCA	C3-C2-C1	2.56	119.04	114.96
4	C	494	HCA	C3-C2-C1	4.17	121.63	114.96

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	A	496	CFM	1	0
5	A	498	CLF	1	0
4	C	494	HCA	1	0
6	C	496	CFM	5	0
5	C	498	CLF	1	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

6.1 Protein, DNA and RNA chains

EDS was not executed - this section will therefore be empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section will therefore be empty.

6.3 Carbohydrates

EDS was not executed - this section will therefore be empty.

6.4 Ligands

EDS was not executed - this section will therefore be empty.

6.5 Other polymers

EDS was not executed - this section will therefore be empty.