W O R L D W I D E
wwPDB
P R O T E I N   D A T A   B A N K

wwPDB X-ray Structure Validation Summary Report ⓘ

Nov 1, 2021 – 12:25 AM EDT

PDB ID	:	2I57
Title	:	Crystal Structure of L-Rhamnose Isomerase from Pseudomonas stutzeri in Complex with D-Allose
Authors	:	Yoshida, H.; Yamada, M.; Takada, G.; Izumori, K.; Kamitori, S.
Deposited on	:	2006-08-24
Resolution	:	1.97 Å(reported)

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

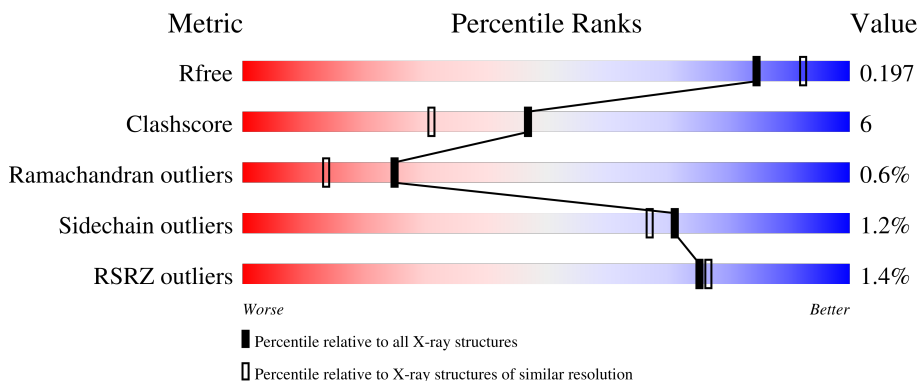|		
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.23.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.23.2

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 1.97 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	Percentile Ranks	Value
Rfree		0.197
Clashscore		6
Ramachandran outliers		0.6%
Sidechain outliers		1.2%
RSRZ outliers		1.4%

Worse   *Better*

▮ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	11647 (2.00-1.96)
Clashscore	141614	1014 (1.98-1.98)
Ramachandran outliers	138981	1006 (1.98-1.98)
Sidechain outliers	138945	1006 (1.98-1.98)
RSRZ outliers	127900	11410 (2.00-1.96)

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 <=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	438	% 82% 13% •
1	B	438	2% 83% 13% •
1	C	438	2% 80% 17% •
1	D	438	% 84% 12% •

2 Entry composition ⓘ

There are 4 unique types of molecules in this entry. The entry contains 14336 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 L-rhamnose isomerase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	419	Total	C	N	O	S	0	0	0
			3248	2040	582	617	9			
1	B	421	Total	C	N	O	S	0	0	0
			3260	2048	584	619	9			
1	C	426	Total	C	N	O	S	0	0	0
			3285	2061	589	626	9			
1	D	419	Total	C	N	O	S	0	0	0
			3251	2042	582	618	9			

There are 36 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	150	ASN	ASP	engineered mutation	UNP Q75WH8
A	431	GLY	-	cloning artifact	UNP Q75WH8
A	432	SER	-	cloning artifact	UNP Q75WH8
A	433	HIS	-	expression tag	UNP Q75WH8
A	434	HIS	-	expression tag	UNP Q75WH8
A	435	HIS	-	expression tag	UNP Q75WH8
A	436	HIS	-	expression tag	UNP Q75WH8
A	437	HIS	-	expression tag	UNP Q75WH8
A	438	HIS	-	expression tag	UNP Q75WH8
B	150	ASN	ASP	engineered mutation	UNP Q75WH8
B	431	GLY	-	cloning artifact	UNP Q75WH8
B	432	SER	-	cloning artifact	UNP Q75WH8
B	433	HIS	-	expression tag	UNP Q75WH8
B	434	HIS	-	expression tag	UNP Q75WH8
B	435	HIS	-	expression tag	UNP Q75WH8
B	436	HIS	-	expression tag	UNP Q75WH8
B	437	HIS	-	expression tag	UNP Q75WH8
B	438	HIS	-	expression tag	UNP Q75WH8
C	150	ASN	ASP	engineered mutation	UNP Q75WH8
C	431	GLY	-	cloning artifact	UNP Q75WH8
C	432	SER	-	cloning artifact	UNP Q75WH8

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PROTEIN DATA BANK

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Chain	Residue	Modelled	Actual	Comment	Reference
C	433	HIS	-	expression tag	UNP Q75WH8
C	434	HIS	-	expression tag	UNP Q75WH8
C	435	HIS	-	expression tag	UNP Q75WH8
C	436	HIS	-	expression tag	UNP Q75WH8
C	437	HIS	-	expression tag	UNP Q75WH8
C	438	HIS	-	expression tag	UNP Q75WH8
D	150	ASN	ASP	engineered mutation	UNP Q75WH8
D	431	GLY	-	cloning artifact	UNP Q75WH8
D	432	SER	-	cloning artifact	UNP Q75WH8
D	433	HIS	-	expression tag	UNP Q75WH8
D	434	HIS	-	expression tag	UNP Q75WH8
D	435	HIS	-	expression tag	UNP Q75WH8
D	436	HIS	-	expression tag	UNP Q75WH8
D	437	HIS	-	expression tag	UNP Q75WH8
D	438	HIS	-	expression tag	UNP Q75WH8

- Molecule 2 is D-ALLOSE (three-letter code: AOS) (formula: $C_6H_{12}O_6$).
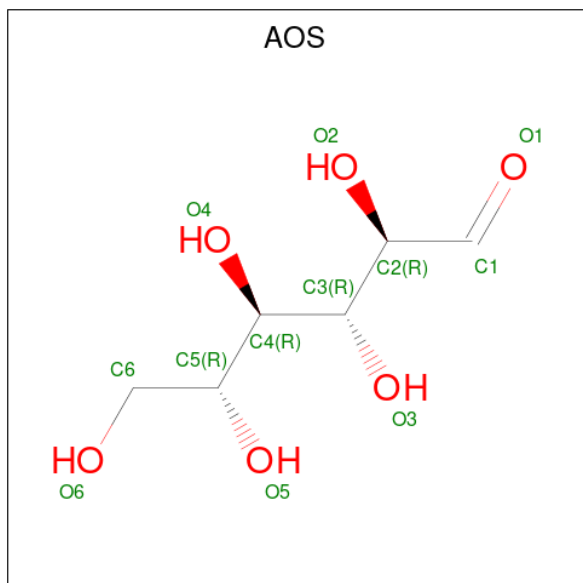
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total 12	C 6	O 6	0	0
2	B	1	Total 12	C 6	O 6	0	0
2	C	1	Total 12	C 6	O 6	0	0
2	D	1	Total 12	C 6	O 6	0	0

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

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

• Molecule 4 is water.

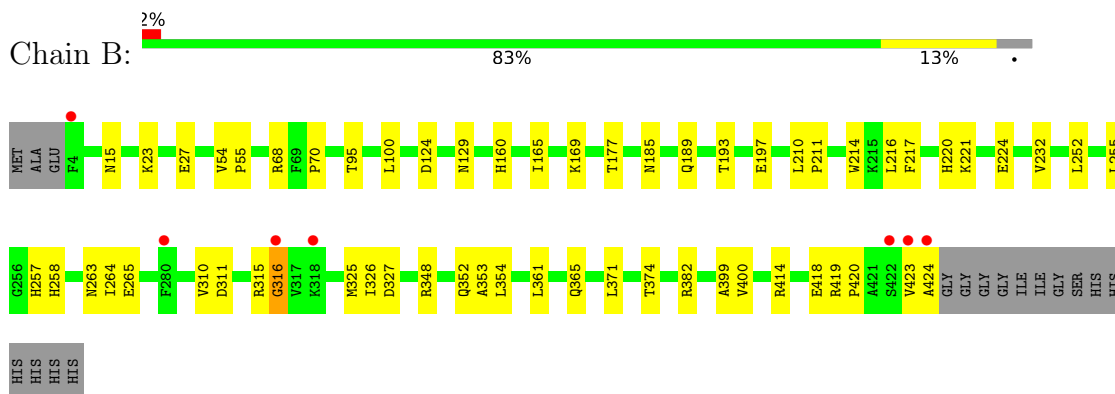| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	336	Total 336	O 336	0	0
4	B	298	Total 298	O 298	0	0
4	C	275	Total 275	O 275	0	0
4	D	327	Total 327	O 327	0	0

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: L-rhamnose isomerase
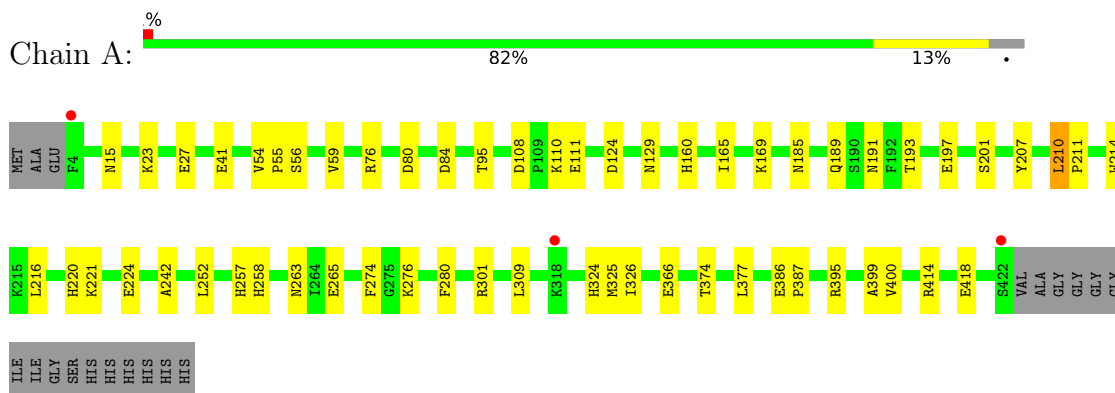
Chain A:

- Molecule 1: L-rhamnose isomerase

Chain B:

- Molecule 1: L-rhamnose isomerase

Chain C:

K378 R379 R382 A399 V400 Y411 R414 G426 G427 G428 ILE ILE GLY SER HIS HIS HIS HIS HIS HIS

• Molecule 1: L-rhamnose isomerase

Chain D:

%

84% 12%

MET ALA E3 F4 N15 K23 E27 T44 E48 V54 F66 A67 R68 F69 P70 T95 H101 I102 P103 D108 P109 K110 E111 M126 N129 L146 H160 I165 K169 N185 Q189 T193 R194 E197 M203 I206 H220

K221 M222 Y223 E224 L252 H257 H258 N263 I264 E265 H281 F320 H321 P322 L361 Q365 T374 L377 R382 A399 V400 R414 E418 R419 P420 A421 SER VAL ALA GLY GLY GLY GLY ILE ILE GLY SER HIS HIS HIS HIS HIS HIS
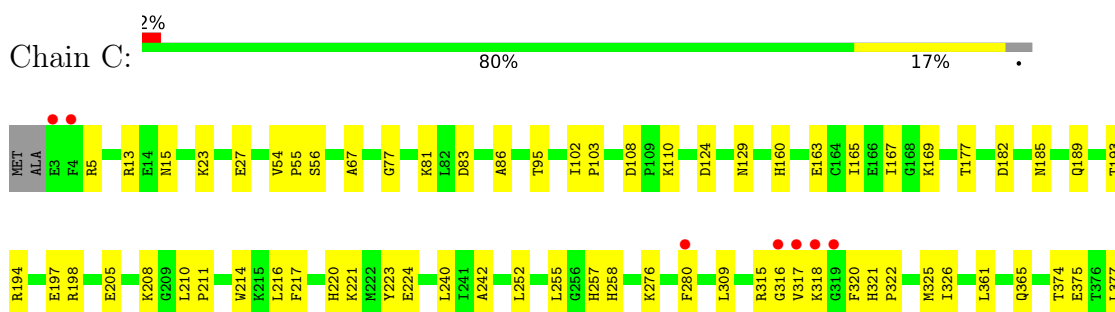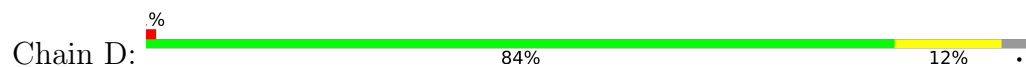
4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	74.65Å 104.73Å 114.53Å 90.00° 108.00° 90.00°	Depositor
Resolution (Å)	33.25 – 1.97 48.32 – 1.97	Depositor EDS
% Data completeness (in resolution range)	97.7 (33.25-1.97) 97.8 (48.32-1.97)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	6.14 (at 1.97Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.172 , 0.204 0.167 , 0.197	Depositor DCC
R_{free} test set	11542 reflections (9.82%)	wwPDB-VP
Wilson B-factor (Å²)	19.1	Xtriage
Anisotropy	0.138	Xtriage
Bulk solvent k_{sol}(e/Å³), B_{sol}(Å²)	0.37 , 47.6	EDS
L-test for twinning[2]	$< |L| > = 0.49, < L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.016 for h,-k,-h-l	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	14336	wwPDB-VP
Average B, all atoms (Å²)	20.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.98% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1]Intensities estimated from amplitudes.
[2]Theoretical values of $< |L| >$, $< L^2 >$ 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: AOS, 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	0.32	0/3320	0.54	0/4501
1	B	0.31	0/3332	0.54	0/4518
1	C	0.30	0/3357	0.53	0/4550
1	D	0.31	0/3323	0.53	0/4505
All	All	0.31	0/13332	0.54	0/18074

There are no bond length outliers.

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	3248	0	3151	39	0
1	B	3260	0	3165	36	0
1	C	3285	0	3183	46	0
1	D	3251	0	3152	39	0
2	A	12	0	12	1	0
2	B	12	0	12	1	0
2	C	12	0	12	0	0
2	D	12	0	11	2	0
3	A	2	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	2	0	0	0	0
3	C	2	0	0	0	0
3	D	2	0	0	0	0
4	A	336	0	0	4	0
4	B	298	0	0	1	0
4	C	275	0	0	1	0
4	D	327	0	0	1	0
All	All	14336	0	12698	159	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 6.

The worst 5 of 159 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:D:203:MET:HE2	1:D:206:ILE:HD12	1.33	1.04
1:D:203:MET:CE	1:D:206:ILE:HD12	2.02	0.89
1:C:129:ASN:H	1:C:160:HIS:HE1	1.26	0.84
1:A:129:ASN:H	1:A:160:HIS:HE1	1.27	0.81
1:C:217:PHE:HB3	1:C:252:LEU:HG	1.63	0.80

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	417/438 (95%)	408 (98%)	8 (2%)	1 (0%)	47	38
1	B	419/438 (96%)	410 (98%)	7 (2%)	2 (0%)	29	16
1	C	424/438 (97%)	411 (97%)	8 (2%)	5 (1%)	13	4
1	D	417/438 (95%)	406 (97%)	9 (2%)	2 (0%)	29	16

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
All	All	1677/1752 (96%)	1635 (98%)	32 (2%)	10 (1%)	25 14

5 of 10 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	318	LYS
1	B	316	GLY
1	C	320	PHE
1	A	224	GLU
1	B	224	GLU

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	329/341 (96%)	324 (98%)	5 (2%)	65	59
1	B	330/341 (97%)	325 (98%)	5 (2%)	65	59
1	C	331/341 (97%)	327 (99%)	4 (1%)	71	67
1	D	329/341 (96%)	327 (99%)	2 (1%)	86	85
All	All	1319/1364 (97%)	1303 (99%)	16 (1%)	71	67

5 of 16 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	374	THR
1	C	377	LEU
1	B	371	LEU
1	C	374	THR
1	B	354	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 22 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	189	GLN
1	D	15	ASN
1	C	344	ASN
1	D	160	HIS
1	B	15	ASN

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 ⓘ

There are no monosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 12 ligands modelled in this entry, 8 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	$\#|Z| > 2$
2	AOS	C	3003	3	10,11,11	0.45	0	13,14,14	0.44	0
2	AOS	B	3002	3	10,11,11	0.88	0	13,14,14	1.25	2 (15%)
2	AOS	A	3001	3	10,11,11	0.51	0	13,14,14	0.48	0
2	AOS	D	3004	3	10,11,11	0.59	0	13,14,14	0.69	0

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
2	AOS	C	3003	3	-	4/14/16/16	-
2	AOS	B	3002	3	-	7/14/16/16	-
2	AOS	A	3001	3	-	2/14/16/16	-
2	AOS	D	3004	3	-	4/14/16/16	-

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	3002	AOS	C5-C4-C3	3.13	117.37	112.47
2	B	3002	AOS	C4-C3-C2	2.12	117.24	113.54

There are no chirality outliers.

5 of 17 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	3002	AOS	C4-C5-C6-O6
2	B	3002	AOS	O5-C5-C6-O6
2	D	3004	AOS	O5-C5-C6-O6
2	B	3002	AOS	C3-C4-C5-O5
2	B	3002	AOS	C3-C4-C5-C6

There are no ring outliers.

3 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	3002	AOS	1	0
2	A	3001	AOS	1	0
2	D	3004	AOS	2	0

5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

There are no chain breaks in this entry.

6   Fit of model and data ⓘ

6.1   Protein, DNA and RNA chains ⓘ

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(Å²)	Q<0.9
1	A	419/438 (95%)	-0.38	3 (0%)	87	88	10, 16, 29, 40	0
1	B	421/438 (96%)	-0.30	7 (1%)	70	71	11, 18, 32, 54	0
1	C	426/438 (97%)	-0.05	9 (2%)	63	65	12, 22, 41, 69	0
1	D	419/438 (95%)	-0.35	4 (0%)	82	83	11, 18, 32, 52	1 (0%)
All	All	1685/1752 (96%)	-0.27	23 (1%)	75	77	10, 18, 34, 69	1 (0%)

The worst 5 of 23 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	319	GLY	5.3
1	B	424	ALA	5.3
1	C	317	VAL	4.9
1	C	318	LYS	4.7
1	D	421	ALA	4.1

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

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

6.3   Carbohydrates ⓘ

There are no monosaccharides in this entry.

6.4   Ligands ⓘ

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(Å^2)	Q<0.9
2	AOS	B	3002	12/12	0.72	0.23	32,36,40,43	0
3	ZN	B	504	1/1	0.78	0.11	58,58,58,58	1
2	AOS	D	3004	12/12	0.86	0.15	29,34,39,40	0
3	ZN	C	506	1/1	0.89	0.08	44,44,44,44	1
2	AOS	C	3003	12/12	0.90	0.12	30,34,37,37	0
2	AOS	A	3001	12/12	0.92	0.14	18,30,37,39	0
3	ZN	B	503	1/1	0.97	0.06	35,35,35,35	0
3	ZN	D	508	1/1	0.98	0.04	27,27,27,27	1
3	ZN	C	505	1/1	0.99	0.03	32,32,32,32	0
3	ZN	A	501	1/1	0.99	0.03	27,27,27,27	0
3	ZN	D	507	1/1	0.99	0.03	25,25,25,25	0
3	ZN	A	502	1/1	0.99	0.02	32,32,32,32	1

6.5 Other polymers ⓘ

There are no such residues in this entry.