



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 05:24 PM UTC

PDB ID : 1SEU / pdb_00001seu
Title : Human DNA Topoisomerase I (70 Kda) In Complex With The Indolocarbazole SA315F and Covalent Complex With A 22 Base Pair DNA Duplex
Authors : Staker, B.L.; Feese, M.D.; Cushman, M.; Pommier, Y.; Zembower, D.; Stewart, L.; Burgin, A.B.
Deposited on : 2004-02-18
Resolution : 3.00 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
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

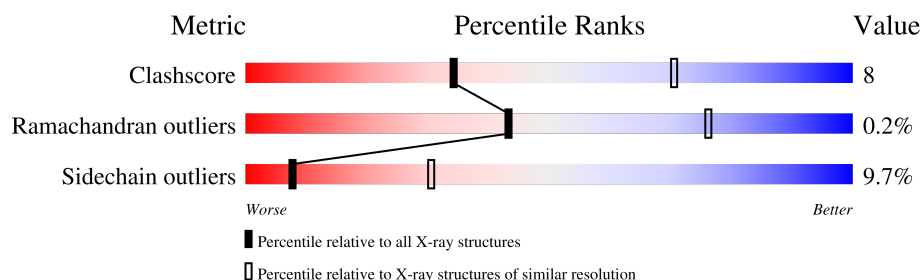
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.00 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	2977 (3.00-3.00)
Ramachandran outliers	187476	2877 (3.00-3.00)
Sidechain outliers	187428	2880 (3.00-3.00)

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 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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	B	10	90% 10%
2	C	12	33% 58% 8%
3	D	22	32% 68%
4	A	592	76% 16% 5%

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
2	TGP	C	11	-	-	X	-
5	SA3	D	990	X	-	-	-

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 5615 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 DNA chain called 5'-D(*AP*AP*AP*AP*AP*GP*AP*CP*TP*T)-3'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	B	10	Total	C	N	O	P	0	0	0
			203	99	42	53	9			

- Molecule 2 is a DNA chain called 5'-D(*(TGP)P*GP*AP*AP*AP*AP*AP*TP*TP*TP*TP*T)-3'.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	C	12	Total	C	N	O	P	S	0	0	0
			246	120	45	69	11	1			

- Molecule 3 is a DNA chain called 5'-D(*AP*AP*AP*AP*AP*TP*TP*TP*TP*TP*CP*CP*AP*AP*GP*TP*CP*TP*TP*TP*TP*T)-3'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	22	Total	C	N	O	P	0	0	0
			443	217	71	134	21			

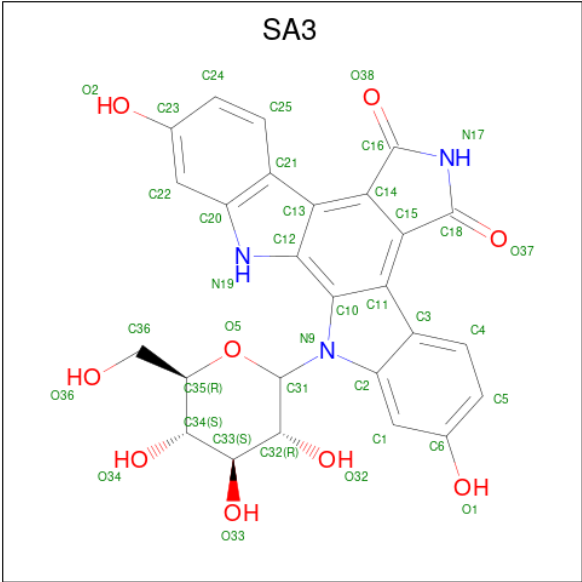
- Molecule 4 is a protein called DNA topoisomerase I.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
4	A	565	Total	C	N	O	P	S	0	0	0
			4685	2979	822	857	1	26			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	722	SER	ASN	engineered mutation	UNP P11387
A	723	PTR	TYR	modified residue	UNP P11387

- Molecule 5 is 2,10-DIHYDROXY-12-(BETA-D-GLUCOPYRANOSYL)-6,7,12,13-TETRAHYDROINDOLO[2,3-A]PYRROLO[3,4-C]CARBAZOLE-5,7-DIONE (CCD ID: SA3) (formula: C₂₆H₂₁N₃O₉).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	D	1	Total	C	N	O	0	0
			38	26	3	9		

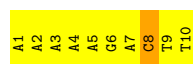
3 Residue-property plots

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. 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. 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: 5'-D(*AP*AP*AP*AP*AP*GP*AP*CP*TP*T)-3'

Chain B: 



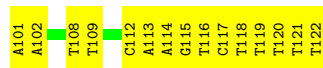
- Molecule 2: 5'-D(*(TGP)P*GP*AP*AP*AP*AP*AP*TP*TP*TP*TP*T)-3'

Chain C: 



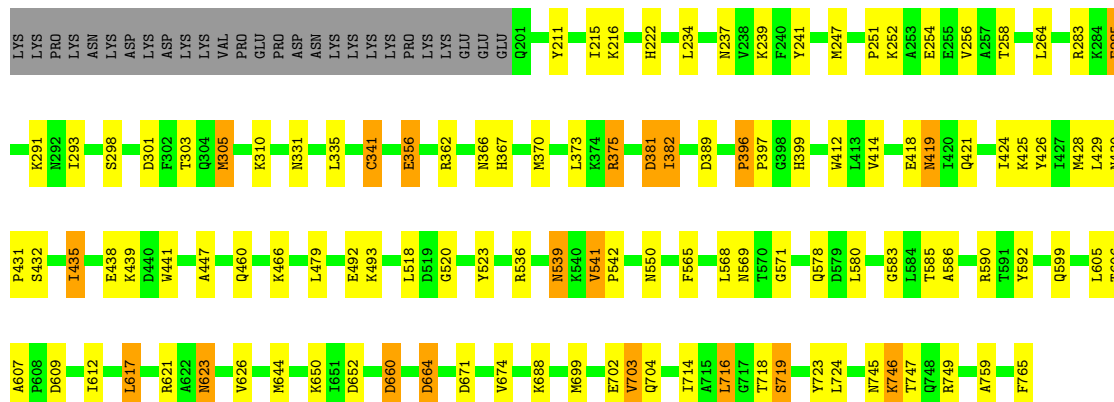
- Molecule 3: 5'-D(*AP*AP*AP*AP*AP*TP*TP*TP*TP*TP*CP*CP*AP*AP*GP*TP*CP*TP*TP*TP*TP*T)-3'

Chain D: 



- Molecule 4: DNA topoisomerase I

Chain A: 



4 Data and refinement statistics

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

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	57.38 Å 115.97 Å 73.55 Å 90.00° 93.71° 90.00°	Depositor
Resolution (Å)	46.63 – 3.00	Depositor
% Data completeness (in resolution range)	80.4 (46.63-3.00)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	0.11	Depositor
Refinement program	CNX 2002	Depositor
R, R_{free}	0.237 , 0.295	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	5615	wwPDB-VP
Average B, all atoms (Å ²)	78.0	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: SA3, TGP, PTR

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	B	0.39	0/229	0.80	1/351 (0.3%)
2	C	0.32	0/254	0.72	1/390 (0.3%)
3	D	0.36	0/494	0.80	0/760
4	A	0.71	3/4768 (0.1%)	1.17	27/6398 (0.4%)
All	All	0.66	3/5745 (0.1%)	1.11	29/7899 (0.4%)

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
4	A	0	1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	612	ILE	CA-CB	9.74	1.59	1.54
4	A	541	VAL	CA-CB	5.97	1.58	1.54
4	A	305	MET	SD-CE	-5.23	1.66	1.79

All (29) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	419	ASN	N-CA-C	8.86	123.19	112.38
4	A	664	ASP	N-CA-C	-7.75	103.95	113.41
4	A	362	ARG	N-CA-C	-6.63	104.36	113.18
4	A	586	ALA	N-CA-C	6.61	120.93	112.34
4	A	688	LYS	N-CA-C	-6.53	105.88	114.31
4	A	239	LYS	N-CA-C	6.46	119.99	109.59

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	382	ILE	N-CA-C	6.32	117.68	108.58
4	A	644	MET	N-CA-C	-6.09	105.33	112.89
4	A	426	TYR	N-CA-C	6.08	118.95	109.52
4	A	580	LEU	N-CA-C	-6.05	106.44	113.88
4	A	447	ALA	N-CA-C	-5.99	105.81	113.23
4	A	264	LEU	N-CA-C	5.95	118.55	111.71
4	A	303	THR	N-CA-C	5.88	118.45	111.33
4	A	650	LYS	N-CA-C	-5.80	106.36	113.50
4	A	520	GLY	N-CA-C	5.80	121.38	114.48
4	A	660	ASP	N-CA-C	-5.76	106.88	114.31
4	A	541	VAL	N-CA-C	5.66	119.92	107.92
1	B	8	DC	C5'-C4'-C3'	-5.49	106.67	114.90
4	A	412	TRP	N-CA-C	5.46	117.92	110.55
4	A	607	ALA	CA-C-N	5.42	125.09	119.56
4	A	607	ALA	C-N-CA	5.42	125.09	119.56
4	A	536	ARG	N-CA-C	5.32	117.93	109.96
4	A	310	LYS	N-CA-C	-5.30	106.31	112.89
4	A	331	ASN	N-CA-C	-5.23	106.05	112.90
4	A	441	TRP	N-CA-C	-5.20	105.52	111.14
4	A	523	TYR	N-CA-C	5.17	117.49	111.02
2	C	22	DT	C2'-C3'-O3'	-5.09	103.86	111.50
4	A	590	ARG	N-CA-C	-5.07	107.23	113.41
4	A	539	ASN	N-CA-C	5.03	116.61	108.26

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
4	A	592	TYR	Sidechain

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	B	203	0	112	15	0
2	C	246	0	138	15	0
3	D	443	0	255	19	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	A	4685	0	4720	37	0
5	D	38	0	18	7	0
All	All	5615	0	5243	82	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 8.

All (82) 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)
3:D:119:DT:H2''	3:D:120:DT:H5''	1.44	0.98
3:D:115:DG:H2'	3:D:116:DT:H71	1.46	0.95
3:D:112:DC:H2''	3:D:113:DA:H5''	1.60	0.81
1:B:1:DA:H2'	1:B:2:DA:C8	2.15	0.81
1:B:9:DT:H2'	1:B:10:DT:H71	1.63	0.80
3:D:121:DT:H2'	3:D:122:DT:H71	1.66	0.76
4:A:569:ASN:HD22	4:A:571:GLY:H	1.36	0.72
1:B:4:DA:H1'	1:B:5:DA:H5''	1.74	0.69
4:A:578:GLN:HE22	4:A:583:GLY:H	1.44	0.65
1:B:2:DA:H1'	1:B:3:DA:C8	2.32	0.65
3:D:119:DT:C2'	3:D:120:DT:H5''	2.25	0.65
1:B:8:DC:H2''	1:B:9:DT:O5'	1.98	0.64
2:C:11:TGP:H5''	4:A:718:THR:HA	1.78	0.64
4:A:247:MET:HE1	4:A:293:ILE:HG21	1.80	0.63
3:D:121:DT:C2'	3:D:122:DT:H71	2.33	0.59
4:A:252:LYS:HG2	4:A:285:GLU:HG3	1.88	0.56
2:C:11:TGP:H5'	5:D:990:SA3:H25	1.87	0.55
4:A:241:TYR:HB2	4:A:301:ASP:HB3	1.89	0.55
2:C:17:DA:H1'	2:C:18:DT:H5''	1.89	0.55
2:C:21:DT:H2'	2:C:22:DT:H72	1.88	0.55
2:C:15:DA:H2	3:D:109:DT:O2	1.90	0.54
3:D:114:DA:C2	3:D:115:DG:C4	2.95	0.54
4:A:382:ILE:HG23	4:A:414:VAL:HG13	1.90	0.54
4:A:367:HIS:O	4:A:370:MET:HG2	2.08	0.53
3:D:115:DG:H2'	3:D:116:DT:C7	2.30	0.53
2:C:11:TGP:H5'	5:D:990:SA3:C25	2.39	0.52
4:A:234:LEU:HD11	4:A:305:MET:HE3	1.91	0.52
1:B:9:DT:H2'	1:B:10:DT:C6	2.45	0.52
4:A:569:ASN:HD22	4:A:571:GLY:N	2.05	0.51
4:A:492:GLU:H	4:A:492:GLU:CD	2.19	0.51
1:B:10:DT:H4'	4:A:723:PTR:O2P	2.09	0.51

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:A:626:VAL:HG11	4:A:724:LEU:HD21	1.93	0.51
4:A:430:ASN:HD22	4:A:432:SER:H	1.59	0.50
4:A:375:ARG:HG3	4:A:419:ASN:ND2	2.25	0.50
4:A:617:LEU:HB2	4:A:703:VAL:HG13	1.94	0.49
5:D:990:SA3:O37	5:D:990:SA3:H4	2.13	0.49
1:B:9:DT:C6	1:B:10:DT:H73	2.48	0.49
2:C:17:DA:H2''	2:C:18:DT:H5''	1.94	0.49
3:D:113:DA:C6	3:D:114:DA:C6	3.00	0.49
1:B:9:DT:H2'	1:B:10:DT:C7	2.38	0.48
1:B:9:DT:C5	1:B:10:DT:H73	2.49	0.48
4:A:256:VAL:HG13	4:A:373:LEU:HD13	1.95	0.47
4:A:418:GLU:HG2	4:A:425:LYS:HD3	1.95	0.47
2:C:11:TGP:N2	2:C:12:DG:C2	2.83	0.47
4:A:216:LYS:HB3	4:A:435:ILE:HD11	1.97	0.47
4:A:719:SER:HA	4:A:723:PTR:HD1	1.96	0.47
3:D:120:DT:H2''	3:D:121:DT:O5'	2.16	0.46
4:A:623:ASN:HB3	4:A:716:LEU:HD22	1.96	0.46
2:C:11:TGP:S5'	5:D:990:SA3:C24	3.04	0.46
4:A:375:ARG:H	4:A:419:ASN:HD21	1.62	0.46
3:D:108:DT:H3'	4:A:746:LYS:NZ	2.31	0.46
1:B:7:DA:H2''	1:B:8:DC:O5'	2.16	0.45
1:B:6:DG:H2'	4:A:424:ILE:HD12	1.99	0.45
4:A:660:ASP:O	4:A:664:ASP:HB2	2.17	0.45
2:C:14:DA:H1'	2:C:15:DA:H5''	1.99	0.44
4:A:375:ARG:NH2	4:A:381:ASP:OD1	2.50	0.44
2:C:17:DA:H2''	2:C:18:DT:C5'	2.48	0.44
3:D:101:DA:H8	3:D:101:DA:H5'	1.83	0.44
1:B:8:DC:H2'	1:B:9:DT:H71	2.00	0.43
4:A:565:PHE:HB3	4:A:568:LEU:HD23	2.00	0.43
2:C:17:DA:C2'	2:C:18:DT:H5''	2.48	0.43
4:A:541:VAL:HA	4:A:542:PRO:HD3	1.88	0.43
4:A:745:ASN:O	4:A:749:ARG:HB2	2.18	0.43
4:A:341:CYS:SG	4:A:429:LEU:HD21	2.59	0.42
2:C:11:TGP:H5'	5:D:990:SA3:C24	2.49	0.42
2:C:11:TGP:N2	2:C:12:DG:N2	2.67	0.42
1:B:9:DT:C6	1:B:10:DT:C7	3.03	0.42
3:D:117:DC:C6	3:D:118:DT:H72	2.54	0.42
4:A:356:GLU:H	4:A:356:GLU:HG2	1.39	0.42
2:C:21:DT:H2''	2:C:22:DT:C6	2.54	0.42
4:A:578:GLN:NE2	4:A:583:GLY:H	2.14	0.41
3:D:101:DA:C2'	3:D:102:DA:C8	3.03	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:D:120:DT:C5'	3:D:120:DT:H6	2.33	0.41
4:A:222:HIS:HB3	4:A:341:CYS:HB2	2.01	0.41
1:B:1:DA:C6	1:B:2:DA:C6	3.08	0.41
3:D:101:DA:H2'	3:D:102:DA:C8	2.55	0.41
4:A:254:GLU:O	4:A:258:THR:HG23	2.21	0.41
3:D:113:DA:H62	5:D:990:SA3:H361	1.85	0.41
4:A:599:GLN:HE22	4:A:765:PHE:H	1.67	0.41
3:D:113:DA:N6	5:D:990:SA3:H361	2.36	0.40
4:A:367:HIS:H	4:A:370:MET:HE2	1.86	0.40
4:A:396:PRO:O	4:A:399:HIS:HB2	2.21	0.40

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
4	A	562/592 (95%)	525 (93%)	36 (6%)	1 (0%)	43 76

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
4	A	759	ALA

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
4	A	504/535 (94%)	455 (90%)	49 (10%)	8 30

All (49) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
4	A	211	TYR
4	A	215	ILE
4	A	237	ASN
4	A	251	PRO
4	A	283	ARG
4	A	285	GLU
4	A	291	LYS
4	A	298	SER
4	A	335	LEU
4	A	341	CYS
4	A	356	GLU
4	A	366	ASN
4	A	375	ARG
4	A	381	ASP
4	A	389	ASP
4	A	396	PRO
4	A	397	PRO
4	A	421	GLN
4	A	428	MET
4	A	431	PRO
4	A	435	ILE
4	A	438	GLU
4	A	439	LYS
4	A	460	GLN
4	A	466	LYS
4	A	479	LEU
4	A	493	LYS
4	A	518	LEU
4	A	539	ASN
4	A	550	ASN
4	A	585	THR
4	A	605	LEU
4	A	606	THR
4	A	609	ASP
4	A	617	LEU
4	A	621	ARG
4	A	623	ASN
4	A	652	ASP

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Mol	Chain	Res	Type
4	A	671	ASP
4	A	674	VAL
4	A	699	MET
4	A	702	GLU
4	A	703	VAL
4	A	704	GLN
4	A	714	ILE
4	A	716	LEU
4	A	719	SER
4	A	746	LYS
4	A	747	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (17) such sidechains are listed below:

Mol	Chain	Res	Type
4	A	277	ASN
4	A	296	ASN
4	A	367	HIS
4	A	399	HIS
4	A	419	ASN
4	A	430	ASN
4	A	459	ASN
4	A	539	ASN
4	A	569	ASN
4	A	578	GLN
4	A	593	ASN
4	A	599	GLN
4	A	620	ASN
4	A	623	ASN
4	A	631	ASN
4	A	697	GLN
4	A	748	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

2 non-standard protein/DNA/RNA residues are modelled in this entry.

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	PTR	A	723	1,4	15,16,17	1.23	0	17,22,24	0.89	0
2	TGP	C	11	2,3	21,21,25	0.36	0	30,31,38	0.29	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
4	PTR	A	723	1,4	-	0/10/11/13	0/1/1/1
2	TGP	C	11	2,3	-	0/6/18/22	0/3/3/3

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.

2 monomers are involved in 9 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	723	PTR	2	0
2	C	11	TGP	7	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

1 ligand is modelled in this entry.

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	$\# Z > 2$
5	SA3	D	990	-	43,44,44	3.43	15 (34%)	63,70,70	1.85	16 (25%)

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
5	SA3	D	990	-	1/1/5/5	1/6/26/26	0/7/7/7

All (15) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	D	990	SA3	O1-C6	-13.58	1.06	1.37
5	D	990	SA3	O2-C23	-11.24	1.11	1.37
5	D	990	SA3	C3-C2	5.63	1.49	1.41
5	D	990	SA3	C1-C6	5.45	1.47	1.39
5	D	990	SA3	C21-C20	4.62	1.48	1.41
5	D	990	SA3	C22-C23	3.85	1.44	1.39
5	D	990	SA3	C2-N9	3.60	1.44	1.40
5	D	990	SA3	C12-C10	3.41	1.49	1.40
5	D	990	SA3	C18-N17	-3.07	1.33	1.38
5	D	990	SA3	C24-C23	2.90	1.44	1.39
5	D	990	SA3	C24-C25	2.71	1.43	1.38
5	D	990	SA3	C1-C2	2.64	1.43	1.39
5	D	990	SA3	C10-N9	2.57	1.43	1.39
5	D	990	SA3	C3-C11	-2.15	1.41	1.46
5	D	990	SA3	C34-C33	2.09	1.57	1.52

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	D	990	SA3	C1-C2-C3	-6.35	114.73	122.04
5	D	990	SA3	C11-C3-C2	4.66	111.18	106.49

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	D	990	SA3	O33-C33-C32	-4.41	99.97	110.38
5	D	990	SA3	C33-C32-C31	-3.92	102.69	108.94
5	D	990	SA3	C35-O5-C31	3.07	118.65	112.54
5	D	990	SA3	C21-C20-N19	-2.98	105.12	109.15
5	D	990	SA3	C10-N9-C31	-2.97	118.73	126.72
5	D	990	SA3	C12-N19-C20	2.76	112.18	108.87
5	D	990	SA3	C4-C3-C11	-2.57	127.38	133.49
5	D	990	SA3	C2-C1-C6	2.56	121.74	117.95
5	D	990	SA3	C13-C21-C20	2.53	108.66	106.21
5	D	990	SA3	C3-C2-N9	-2.30	104.81	108.94
5	D	990	SA3	C22-C20-N19	2.25	132.51	128.94
5	D	990	SA3	C25-C24-C23	2.21	122.21	119.88
5	D	990	SA3	C13-C14-C16	2.11	133.50	130.53
5	D	990	SA3	O32-C32-C33	2.09	115.31	110.38

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
5	D	990	SA3	C31

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	D	990	SA3	O5-C35-C36-O36

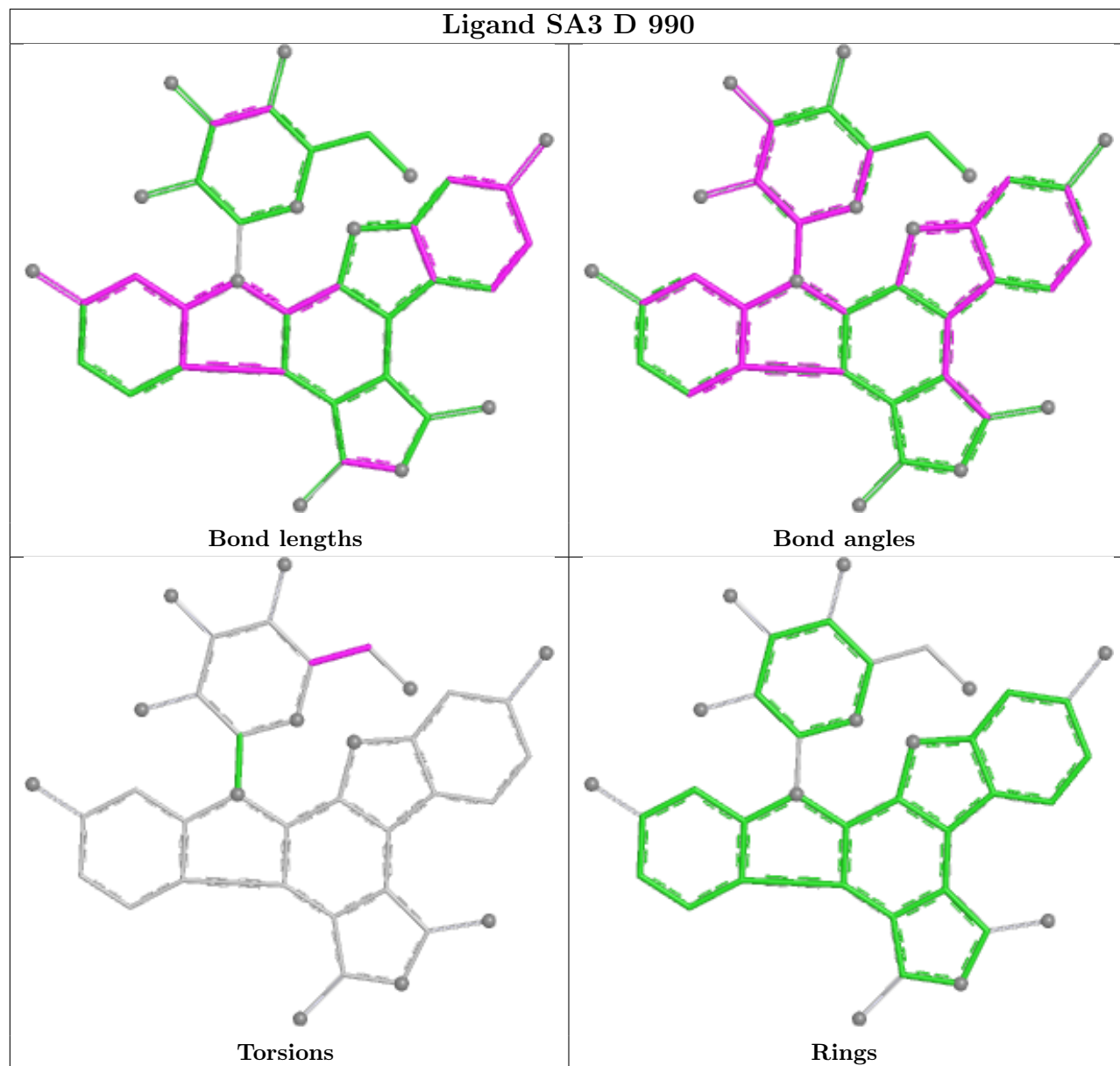
There are no ring outliers.

1 monomer is involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	D	990	SA3	7	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient

equivalents in the CSD to analyse the geometry.



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 is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.