Full wwPDB X-ray Structure Validation Report ⓘ

Apr 4, 2026 – 09:39 PM UTC

PDB ID	:	10HF / pdb_000010hf
Title	:	[17,17,7-7N_3T] Isosceles tensegrity triangle with 17, 17 and 7 base pairs between junctions, three turn edges
Authors	:	Vecchioni, S.; Woloszyn, K.; Sha, R.; Ohayon, Y.P.
Deposited on	:	2026-01-19
Resolution	:	7.24 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:

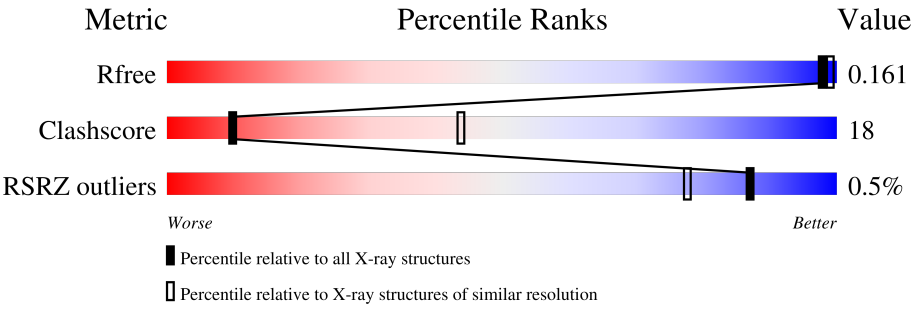
MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

1 Overall quality at a glance (i)

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

The reported resolution of this entry is 7.24 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	1167 (10.00-4.00)
Clashscore	190562	1000 (10.00-4.06)
RSRZ outliers	180081	1161 (10.00-4.00)

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 <=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	31	39% 61%
2	B	19	47% 53%
3	C	31	3% 19% 81%
4	D	14	21% 79%
5	E	31	35% 65%
6	F	19	21% 79%
7	G	41	51% 49%

2 Entry composition (i)

There are 7 unique types of molecules in this entry. The entry contains 3792 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 DNA (31-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
1	A	31	637	303	120	184	30	0	0	0

- Molecule 2 is a DNA chain called DNA (5'-D(*TP*GP*TP*GP*AP*TP*GP*TP*GP*GP*TP*AP*GP*AP*CP*TP*CP*AP*G)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	B	19	393	188	73	114	18	0	0	0

- Molecule 3 is a DNA chain called DNA (31-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
3	C	31	639	305	124	180	30	0	0	0

- Molecule 4 is a DNA chain called DNA (5'-D(*TP*TP*CP*GP*TP*AP*GP*TP*GP*GP*TP*CP*GP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
4	D	14	285	137	49	86	13	0	0	0

- Molecule 5 is a DNA chain called DNA (31-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
5	E	31	625	299	109	187	30	0	0	0

- Molecule 6 is a DNA chain called DNA (5'-D(*TP*CP*AP*GP*CP*TP*CP*AP*CP*TP*CP*GP*TP*GP*GP*TP*AP*TP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
6	F	19	Total	C	N	O	P	0	0	0
			382	184	65	115	18			

- Molecule 7 is a DNA chain called DNA (41-MER).

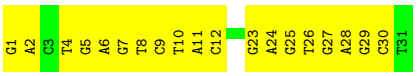
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
7	G	41	Total	C	N	O	P	0	0	0
			831	396	159	236	40			

3 Residue-property plots (i)

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.

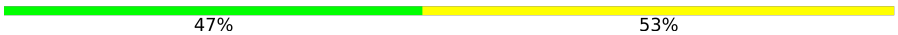
• Molecule 1: DNA (31-MER)

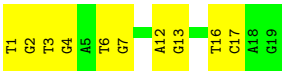
Chain A:



• Molecule 2: DNA (5'-D(*TP*GP*TP*GP*AP*TP*GP*TP*GP*GP*TP*AP*GP*AP*CP*TP*CP*AP*G)-3')

Chain B:



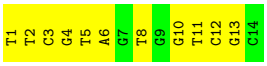


• Molecule 3: DNA (31-MER)

Chain C:

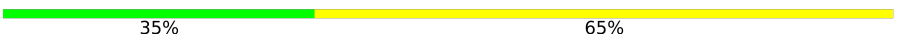
• Molecule 4: DNA (5'-D(*TP*TP*CP*GP*TP*AP*GP*TP*GP*GP*TP*CP*GP*C)-3')

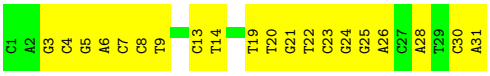
Chain D:



• Molecule 5: DNA (31-MER)

Chain E:



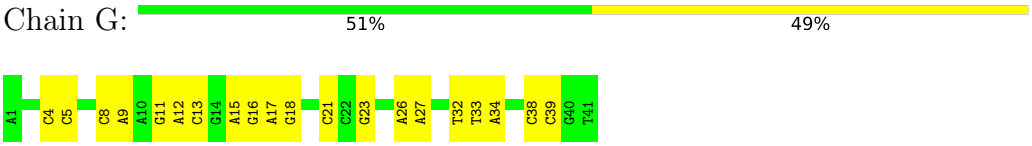


• Molecule 6: DNA (5'-D(*TP*CP*AP*GP*CP*TP*CP*AP*CP*TP*CP*GP*TP*GP*GP*TP*AP*TP*C)-3')

Chain F:

• Molecule 7: DNA (41-MER)

Chain G:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α, β, γ	91.67Å 99.53Å 100.32Å 83.09° 62.81° 66.03°	Depositor
Resolution (Å)	44.47 – 7.24 44.47 – 7.24	Depositor EDS
% Data completeness (in resolution range)	58.1 (44.47-7.24) 47.7 (44.47-7.24)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	0.93 (at 7.43Å)	Xtriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, R_{free}	0.142 , 0.162 0.140 , 0.161	Depositor DCC
R_{free} test set	125 reflections (3.05%)	wwPDB-VP
Wilson B-factor (Å^2)	-40.3	Xtriage
Anisotropy	1.717	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	-0.71 , 55.0	EDS
L-test for twinning[2]	$< \|L\| > = 0.42$, $< L^2 > = 0.25$	Xtriage
Estimated twinning fraction	0.080 for -h,-l,-k	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	3792	wwPDB-VP
Average B, all atoms (Å^2)	426.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 19.96 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 9.6501e-03.*

[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

5.1 Standard geometry

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	0.24	0/715	0.48	0/1103
2	B	0.23	0/441	0.49	0/681
3	C	0.23	0/719	0.45	0/1109
4	D	0.23	0/318	0.50	0/490
5	E	0.28	0/698	0.58	0/1074
6	F	0.27	0/426	0.53	0/655
7	G	0.23	0/933	0.46	0/1435
All	All	0.24	0/4250	0.50	0/6547

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

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	637	0	350	15	0
2	B	393	0	217	9	0
3	C	639	0	350	30	0
4	D	285	0	161	9	0
5	E	625	0	351	15	0
6	F	382	0	217	11	0
7	G	831	0	459	18	0
All	All	3792	0	2105	103	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 18.

All (103) 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:7:DG:H2'	1:A:8:DT:C6	2.17	0.79
5:E:13:DC:H2'	5:E:14:DT:H71	1.72	0.71
3:C:15:DT:H2"	3:C:16:DA:H5"	1.74	0.70
1:A:9:DC:H2'	1:A:10:DT:H71	1.75	0.69
6:F:2:DC:H2"	6:F:3:DA:H5"	1.76	0.67
7:G:15:DA:H2"	7:G:16:DG:H5"	1.77	0.66
3:C:23:DC:H42	7:G:23:DG:H1	1.44	0.66
3:C:13:DA:H1'	3:C:14:DA:H5'	1.78	0.66
5:E:21:DG:H2'	5:E:22:DT:H71	1.78	0.65
5:E:20:DT:H2"	5:E:21:DG:C8	2.32	0.65
3:C:9:DT:H2'	3:C:10:DG:C8	2.34	0.63
3:C:4:DA:H2"	3:C:5:DT:H5"	1.81	0.63
3:C:22:DA:H5'	3:C:22:DA:H8	1.64	0.63
7:G:11:DG:H2"	7:G:12:DA:H5"	1.83	0.61
2:B:16:DT:H2"	2:B:17:DC:C5	2.38	0.58
1:A:5:DG:H2"	1:A:6:DA:C8	2.40	0.56
2:B:12:DA:H2"	2:B:13:DG:H5"	1.86	0.56
6:F:3:DA:H2'	6:F:4:DG:C8	2.41	0.56
6:F:17:DA:H2'	6:F:18:DT:C6	2.41	0.56
1:A:28:DA:H1'	1:A:29:DG:C8	2.41	0.55
3:C:22:DA:H5'	3:C:22:DA:C8	2.42	0.54
1:A:7:DG:H2"	1:A:8:DT:H5'	1.89	0.53
3:C:2:DA:H2'	3:C:3:DG:C8	2.44	0.53
5:E:6:DA:H1'	5:E:7:DC:H5'	1.90	0.53
5:E:21:DG:H2"	5:E:22:DT:H5"	1.89	0.53
4:D:12:DC:H2"	4:D:13:DG:C8	2.44	0.53
6:F:11:DC:H2"	6:F:12:DG:C8	2.44	0.53
3:C:18:DG:H2"	3:C:19:DT:H5'	1.91	0.53
7:G:26:DA:H2"	7:G:27:DA:C8	2.44	0.52
3:C:28:DT:H2"	3:C:29:DA:C8	2.45	0.51
5:E:25:DG:H4'	5:E:26:DA:OP1	2.11	0.51
3:C:5:DT:H2"	3:C:6:DA:H8	1.76	0.50
6:F:7:DC:H2"	6:F:8:DA:C8	2.46	0.50
2:B:3:DT:H2"	2:B:4:DG:H8	1.77	0.50
3:C:3:DG:H2'	3:C:4:DA:C8	2.46	0.50
3:C:25:DG:C2	3:C:26:DA:C5	3.00	0.49
4:D:1:DT:H2'	4:D:2:DT:C6	2.48	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
6:F:14:DG:H2'	6:F:15:DG:C8	2.48	0.49
2:B:3:DT:H2"	2:B:4:DG:C8	2.48	0.48
7:G:4:DC:H2'	7:G:5:DC:C5	2.49	0.48
2:B:16:DT:H2"	2:B:17:DC:C6	2.49	0.47
2:B:1:DT:H3'	2:B:2:DG:H8	1.78	0.47
7:G:17:DA:H2"	7:G:18:DG:H8	1.79	0.47
2:B:7:DG:C2	5:E:28:DA:C2	3.02	0.47
6:F:17:DA:H2'	6:F:18:DT:H6	1.78	0.47
6:F:10:DT:H2"	6:F:11:DC:C5	2.49	0.47
3:C:14:DA:H2"	3:C:15:DT:H5"	1.97	0.47
2:B:1:DT:H5"	2:B:2:DG:C8	2.50	0.46
3:C:21:DG:C2	3:C:22:DA:C5	3.03	0.46
6:F:5:DC:H2"	6:F:6:DT:C6	2.50	0.46
4:D:3:DC:H2"	4:D:4:DG:C8	2.50	0.46
7:G:8:DC:H2"	7:G:9:DA:C8	2.51	0.46
7:G:4:DC:H2'	7:G:5:DC:C6	2.51	0.46
7:G:32:DT:H4'	7:G:33:DT:OP1	2.15	0.46
5:E:19:DT:H2"	5:E:20:DT:C6	2.52	0.45
1:A:23:DG:H2"	1:A:24:DA:C8	2.51	0.45
1:A:25:DG:H2'	1:A:26:DT:H71	1.98	0.45
3:C:2:DA:H2'	3:C:3:DG:H8	1.81	0.45
3:C:25:DG:H4'	3:C:26:DA:OP1	2.17	0.45
7:G:11:DG:H2"	7:G:12:DA:H8	1.82	0.45
3:C:2:DA:H8	3:C:2:DA:O5'	2.00	0.45
5:E:23:DC:H2"	5:E:24:DG:C8	2.51	0.45
7:G:11:DG:C2	7:G:12:DA:C5	3.05	0.44
4:D:11:DT:H2"	4:D:12:DC:C5	2.53	0.44
1:A:11:DA:H1'	1:A:12:DC:H5'	1.99	0.44
3:C:10:DG:H2'	3:C:11:DA:C8	2.53	0.44
3:C:13:DA:C2	3:C:14:DA:C4	3.06	0.44
5:E:5:DG:H2"	5:E:6:DA:C8	2.53	0.44
7:G:32:DT:H2"	7:G:33:DT:H5"	1.99	0.44
3:C:15:DT:H2"	3:C:16:DA:C8	2.53	0.44
4:D:6:DA:C8	4:D:6:DA:H5'	2.53	0.43
1:A:8:DT:H2"	1:A:9:DC:H5"	2.00	0.43
3:C:5:DT:H2"	3:C:6:DA:C8	2.53	0.43
3:C:15:DT:H2"	3:C:16:DA:H8	1.83	0.43
3:C:30:DC:H2"	3:C:31:DG:C8	2.54	0.43
3:C:20:DT:H2"	3:C:21:DG:C8	2.52	0.43
1:A:29:DG:H2"	1:A:30:DC:C6	2.54	0.43
5:E:3:DG:H2"	5:E:4:DC:O5'	2.19	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:E:30:DC:H2"	5:E:31:DA:H8	1.83	0.43
7:G:12:DA:H2"	7:G:13:DC:O5'	2.17	0.43
5:E:8:DC:H2'	5:E:9:DT:C6	2.54	0.43
4:D:8:DT:H2'	7:G:21:DC:O4'	2.19	0.42
4:D:10:DG:H2"	4:D:11:DT:H5'	2.01	0.42
1:A:6:DA:H2"	1:A:7:DG:H8	1.84	0.42
3:C:6:DA:C2	6:F:17:DA:C2	3.07	0.42
3:C:25:DG:H2"	3:C:26:DA:O5'	2.18	0.42
3:C:3:DG:H2'	3:C:4:DA:H8	1.84	0.42
1:A:4:DT:H2"	1:A:5:DG:N7	2.34	0.42
1:A:1:DG:H2"	1:A:2:DA:C8	2.55	0.42
2:B:6:DT:H2"	2:B:7:DG:H8	1.85	0.41
4:D:4:DG:H1'	4:D:5:DT:H5'	2.01	0.41
7:G:32:DT:C6	7:G:33:DT:H72	2.55	0.41
3:C:5:DT:H1'	3:C:6:DA:H5'	2.02	0.41
5:E:8:DC:H2'	5:E:9:DT:H6	1.85	0.41
5:E:3:DG:H2'	5:E:4:DC:C6	2.56	0.41
6:F:13:DT:H2"	6:F:14:DG:OP1	2.21	0.41
7:G:17:DA:H2"	7:G:18:DG:C8	2.55	0.41
3:C:24:DG:H2"	3:C:25:DG:C8	2.56	0.41
4:D:3:DC:H2"	4:D:4:DG:H8	1.86	0.40
7:G:33:DT:H2"	7:G:34:DA:C8	2.56	0.40
1:A:29:DG:H2"	1:A:30:DC:H6	1.86	0.40
7:G:38:DC:H2'	7:G:39:DC:C6	2.56	0.40
1:A:27:DG:H2"	1:A:28:DA:H5'	2.03	0.40

There are no symmetry-related clashes.

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

There are no protein molecules in this entry.

5.3.2 Protein sidechains (i)

There are no protein molecules in this entry.

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 oligosaccharides in this entry.

5.6 Ligand geometry

There are no ligands in this entry.

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, 95^{th} 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	31/31 (100%)	0.04	0 100 100	319, 482, 652, 664	0
2	B	19/19 (100%)	-0.44	0 100 100	336, 438, 591, 604	0
3	C	31/31 (100%)	-0.26	1 (3%) 50 45	297, 382, 449, 470	0
4	D	14/14 (100%)	-0.36	0 100 100	345, 408, 515, 542	0
5	E	31/31 (100%)	-0.38	0 100 100	356, 426, 488, 490	0
6	F	19/19 (100%)	-0.46	0 100 100	331, 416, 629, 638	0
7	G	41/41 (100%)	-0.31	0 100 100	332, 385, 412, 430	0
All	All	186/186 (100%)	-0.29	1 (0%) 87 78	297, 405, 604, 664	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	C	20	DT	2.4

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 oligosaccharides in this entry.

6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.