



# Full wwPDB X-ray Structure Validation Report ⓘ

May 14, 2020 – 01:40 pm BST

PDB ID : 5BN8  
Title : Crystal structure of nucleotide-free human Hsp70 NBD.  
Authors : Narayanan, D.; Engh, R.A.  
Deposited on : 2015-05-25  
Resolution : 1.34 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](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.

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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 : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.11  
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) : 2.11

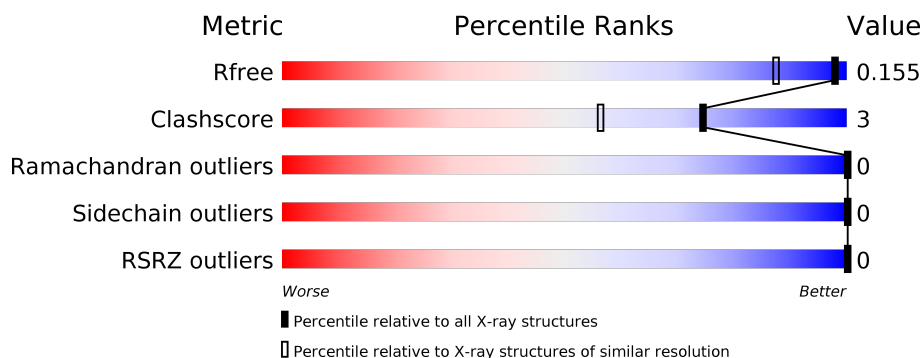
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 1.34 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))
$R_{free}$	130704	1385 (1.36-1.32)
Clashscore	141614	1417 (1.36-1.32)
Ramachandran outliers	138981	1397 (1.36-1.32)
Sidechain outliers	138945	1397 (1.36-1.32)
RSRZ outliers	127900	1369 (1.36-1.32)

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  $\geq 3$ , 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	388	

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	PO4	A	407[A]	-	X	X	-

## 2 Entry composition [i](#)

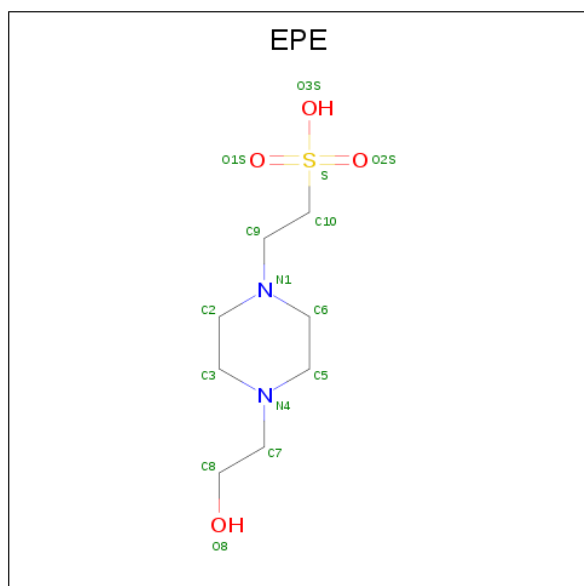
There are 7 unique types of molecules in this entry. The entry contains 3708 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Heat shock 70 kDa protein 1A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	379	Total	C	N	O	S	0	20	1
			3088	1944	542	594	8			

- Molecule 2 is 4-(2-HYDROXYETHYL)-1-PIPERAZINE ETHANESULFONIC ACID (three-letter code: EPE) (formula: C<sub>8</sub>H<sub>18</sub>N<sub>2</sub>O<sub>4</sub>S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	S	0	0
			15	8	2	4	1		

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	2	Total	Mg	0	0
			2	2		

- Molecule 4 is PHOSPHATE ION (three-letter code: PO4) (formula: O<sub>4</sub>P).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	O	P	0	0
			5	4	1		
4	A	1	Total	O	P	0	0
			4	3	1		
4	A	1	Total	O	P	0	0
			5	4	1		
4	A	1	Total	O	P	0	1
			10	8	2		

- Molecule 5 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	1	Total	Cl	0	0
			1	1		

- Molecule 6 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	1	Total	Na	0	0
			1	1		

- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	577	Total 577	O 577	0	0



- Molecule 1: Heat shock 70 kDa protein 1A

R342	I343	P344	F354	I364	P365	D366	G372	G382	ASP	LVS	SEN	GLU	ASN	VAL	MET	ALA	LVS	A4	T14	Y15	S40	D46	R49	D69	M87	V94	D99	K100	K108	G109	E110	R155	R171	A178	R187	I197	G201	D234	R258	E268	K271	D285	S286	D292	R311	E315	V335	S340	E344
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## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	46.13 Å 63.70 Å 144.12 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	38.35 – 1.34 38.35 – 1.34	Depositor EDS
% Data completeness (in resolution range)	97.3 (38.35-1.34) 97.3 (38.35-1.34)	Depositor EDS
$R_{merge}$	0.04	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.95 (at 1.34 Å)	Xtriage
Refinement program	REFMAC 5.8.0071	Depositor
R, $R_{free}$	0.131 , 0.154 0.132 , 0.155	Depositor DCC
$R_{free}$ test set	2000 reflections (2.13%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	10.7	Xtriage
Anisotropy	1.436	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 47.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.98	EDS
Total number of atoms	3708	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	22.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.12% 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: NA, MG, EPE, PO4, CL

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	1.13	7/3155 (0.2%)	1.05	10/4263 (0.2%)

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	110[A]	GLU	CD-OE2	7.08	1.33	1.25
1	A	110[B]	GLU	CD-OE2	7.08	1.33	1.25
1	A	344	PRO	N-CD	-6.58	1.38	1.47
1	A	354	PHE	CG-CD2	5.59	1.47	1.38
1	A	15	TYR	CG-CD2	5.58	1.46	1.39
1	A	40	SER	CB-OG	5.32	1.49	1.42
1	A	99	ASP	CB-CG	5.21	1.62	1.51

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	187	ARG	NE-CZ-NH2	-7.83	116.38	120.30
1	A	171	ARG	NE-CZ-NH2	-7.32	116.64	120.30
1	A	292	ASP	CB-CG-OD1	6.82	124.43	118.30
1	A	187	ARG	NE-CZ-NH1	6.15	123.38	120.30
1	A	49[A]	ARG	NE-CZ-NH1	-6.14	117.23	120.30
1	A	49[B]	ARG	NE-CZ-NH1	-6.14	117.23	120.30
1	A	155	ARG	NE-CZ-NH2	-5.50	117.55	120.30
1	A	69	ASP	CB-CG-OD1	5.45	123.21	118.30
1	A	258[A]	ARG	NE-CZ-NH1	5.04	122.82	120.30
1	A	258[B]	ARG	NE-CZ-NH1	5.04	122.82	120.30

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	3088	0	3078	20	1
2	A	15	0	18	0	0
3	A	2	0	0	0	0
4	A	24	0	0	6	0
5	A	1	0	0	0	0
6	A	1	0	0	0	0
7	A	577	0	0	3	2
All	All	3708	0	3096	20	2

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 3.

All (20) 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:14:THR:OG1	4:A:407[A]:PO4:O3	2.04	0.76
1:A:14:THR:H	4:A:407[A]:PO4:P	2.18	0.66
1:A:342:ARG:NH1	1:A:366[B]:ASP:OD2	2.33	0.62
1:A:14:THR:N	4:A:407[A]:PO4:O2	2.31	0.60
1:A:271[B]:LYS:NZ	1:A:340:SER:OG	2.37	0.58
1:A:14:THR:HG1	4:A:407[A]:PO4:P	2.28	0.56
1:A:286:SER:N	1:A:292:ASP:OD1	2.39	0.51
1:A:197[B]:ILE:HD12	1:A:197[B]:ILE:N	2.28	0.49
1:A:311:ARG:NH2	7:A:509:HOH:O	2.44	0.48
1:A:315[A]:GLU:HG2	7:A:685:HOH:O	2.13	0.48
1:A:201:GLY:HA3	4:A:407[B]:PO4:O4	2.14	0.47
1:A:14:THR:OG1	4:A:407[A]:PO4:P	2.72	0.47
1:A:197[A]:ILE:HD13	1:A:335:VAL:HB	1.98	0.46
1:A:178:ALA:O	1:A:372:GLY:HA3	2.16	0.46
1:A:46:ASP:O	1:A:108:LYS:HA	2.16	0.45
1:A:100:LYS:NZ	7:A:506:HOH:O	2.42	0.42
1:A:285:ASP:HA	1:A:292:ASP:OD1	2.20	0.42
1:A:342:ARG:NH2	1:A:364[B]:ASN:OD1	2.53	0.42
1:A:234:ASP:OD2	1:A:268[B]:GLU:HG2	2.21	0.41
1:A:87[B]:MET:HE3	1:A:94:VAL:HB	2.03	0.40

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:315[A]:GLU:OE1	7:A:561:HOH:O[1_655]	1.93	0.27
7:A:881:HOH:O	7:A:998:HOH:O[3_545]	2.05	0.15

## 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	397/388 (102%)	396 (100%)	1 (0%)	0	100	100

There are no Ramachandran outliers to report.

### 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	331/321 (103%)	331 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 5.3.3 RNA [i](#)

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 carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

Of 10 ligands modelled in this entry, 4 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	PO4	A	405	-	0,3,4	0.00	-	0,3,6	0.00	-
4	PO4	A	407[B]	3	4,4,4	1.28	0	6,6,6	1.84	2 (33%)
4	PO4	A	406	-	4,4,4	2.41	2 (50%)	6,6,6	0.57	0
2	EPE	A	401	-	15,15,15	2.17	2 (13%)	18,20,20	1.35	3 (16%)
4	PO4	A	404	3,6	4,4,4	2.47	2 (50%)	6,6,6	0.96	0
4	PO4	A	407[A]	3	4,4,4	1.70	1 (25%)	6,6,6	2.78	4 (66%)

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	EPE	A	401	-	-	3/9/19/19	0/1/1/1

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	401	EPE	C10-S	-7.45	1.66	1.77
4	A	406	PO4	P-O2	-4.13	1.42	1.54

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	404	PO4	P-O1	3.51	1.59	1.50
4	A	404	PO4	P-O3	-2.96	1.45	1.54
4	A	407[A]	PO4	P-O2	-2.46	1.47	1.54
4	A	406	PO4	P-O3	-2.43	1.47	1.54
2	A	401	EPE	C9-C10	-2.27	1.46	1.52

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	407[A]	PO4	O4-P-O1	-4.17	95.62	110.89
4	A	407[B]	PO4	O4-P-O2	3.27	118.48	107.97
4	A	407[A]	PO4	O4-P-O2	3.17	118.16	107.97
4	A	407[A]	PO4	O2-P-O1	-3.09	99.59	110.89
4	A	407[A]	PO4	O4-P-O3	2.85	117.11	107.97
4	A	407[B]	PO4	O4-P-O1	-2.50	101.75	110.89
2	A	401	EPE	C9-N1-C6	2.27	117.03	111.23
2	A	401	EPE	C5-C6-N1	-2.24	106.05	110.64
2	A	401	EPE	C9-N1-C2	-2.24	105.52	111.23

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	401	EPE	N4-C7-C8-O8
2	A	401	EPE	C8-C7-N4-C3
2	A	401	EPE	C8-C7-N4-C5

There are no ring outliers.

2 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	407[B]	PO4	1	0
4	A	407[A]	PO4	5	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 [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	379/388 (97%)	-0.30	0 100 100	10, 17, 34, 56	0

There are no RSRZ outliers to report.

### 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 carbohydrates 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(Å <sup>2</sup> )	Q<0.9
4	PO4	A	405	4/5	0.87	0.23	22,22,23,29	4
2	EPE	A	401	15/15	0.96	0.07	19,29,43,51	5
4	PO4	A	406	5/5	0.97	0.09	22,24,32,33	4
6	NA	A	409	1/1	0.97	0.09	40,40,40,40	0
4	PO4	A	407[B]	5/5	0.98	0.14	14,14,15,17	5
4	PO4	A	404	5/5	0.98	0.11	11,12,14,14	5
4	PO4	A	407[A]	5/5	0.98	0.14	15,16,22,24	5
3	MG	A	402	1/1	0.99	0.04	27,27,27,27	0
3	MG	A	403	1/1	1.00	0.07	13,13,13,13	1
5	CL	A	408	1/1	1.00	0.05	15,15,15,15	1

## 6.5 Other polymers [i](#)

There are no such residues in this entry.