



# Full wwPDB X-ray Structure Validation Report ⓘ

Jan 31, 2016 – 10:27 PM GMT

PDB ID : 1TPW  
Title : TRIOSEPHOSPHATE ISOMERASE DRINKS WATER TO KEEP HEALTHY  
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Deposited on : 1994-11-07  
Resolution : 1.90 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  
<http://wwpdb.org/validation/2016/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 : 1.7 (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

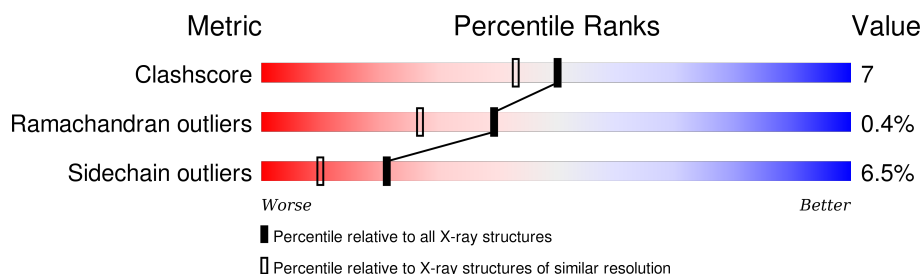
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.90 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	5398 (1.90-1.90)
Ramachandran outliers	100387	5338 (1.90-1.90)
Sidechain outliers	100360	5339 (1.90-1.90)

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. 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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	247	 77% 17% . .
1	B	247	 82% 14% . .

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 4015 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.

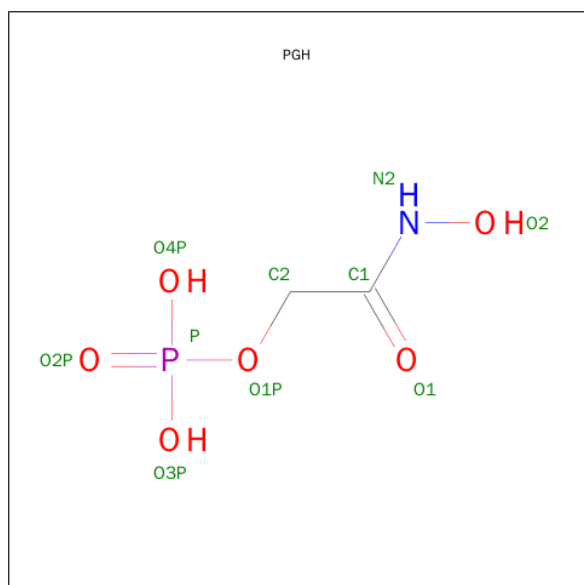
- Molecule 1 is a protein called TRIOSEPHOSPHATE ISOMERASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	245	Total	C	N	O	S	0	0	0
			1857	1178	325	348	6			
1	B	245	Total	C	N	O	S	0	0	0
			1857	1178	325	348	6			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	96	PRO	SER	CONFLICT	UNP P00940
A	194	THR	SER	CONFLICT	UNP P00940
B	96	PRO	SER	CONFLICT	UNP P00940
B	194	THR	SER	CONFLICT	UNP P00940

- Molecule 2 is PHOSPHOGLYCOLOHYDROXAMIC ACID (three-letter code: PGH) (formula:  $C_2H_6NO_6P$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			10	2	1	6	1		
2	B	1	Total	C	N	O	P	0	0
			10	2	1	6	1		

- Molecule 3 is water.

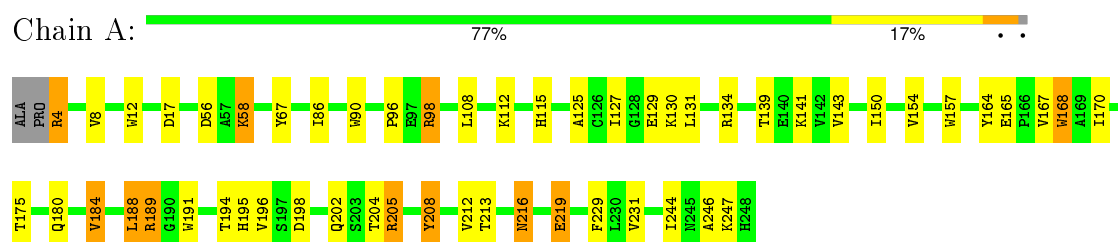
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	140	Total	O	0	0
			140	140		
3	B	141	Total	O	0	0
			141	141		

### 3 Residue-property plots

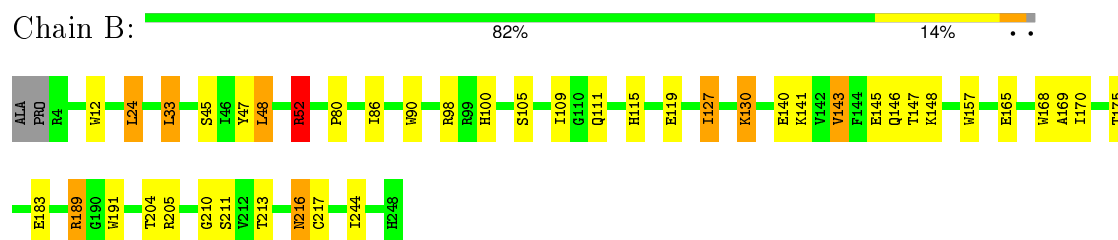
These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according 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: TRIOSEPHOSPHATE ISOMERASE



#### • Molecule 1: TRIOSEPHOSPHATE ISOMERASE



## 4 Data and refinement statistics

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

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	136.20 Å 74.30 Å 53.50 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	(Not available) – 1.90	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-1.90)	Depositor
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	X-PLOR	Depositor
R, $R_{free}$	0.202 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	4015	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	14.0	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: PGH

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	0.92	0/1893	1.55	25/2556 (1.0%)
1	B	0.90	0/1893	1.63	29/2556 (1.1%)
All	All	0.91	0/3786	1.59	54/5112 (1.1%)

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

There are no bond length outliers.

All (54) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	52	ARG	NE-CZ-NH1	23.66	132.13	120.30
1	B	52	ARG	NE-CZ-NH2	-23.05	108.78	120.30
1	A	189	ARG	NE-CZ-NH2	-16.56	112.02	120.30
1	A	189	ARG	NE-CZ-NH1	15.03	127.82	120.30
1	B	189	ARG	NE-CZ-NH2	-13.07	113.76	120.30
1	B	189	ARG	NE-CZ-NH1	12.96	126.78	120.30
1	A	157	TRP	CD1-CG-CD2	9.51	113.90	106.30
1	B	168	TRP	CD1-CG-CD2	8.93	113.44	106.30
1	A	98	ARG	NE-CZ-NH1	8.68	124.64	120.30
1	A	90	TRP	CD1-CG-CD2	8.60	113.18	106.30
1	B	98	ARG	NE-CZ-NH2	-8.44	116.08	120.30
1	B	90	TRP	CD1-CG-CD2	8.32	112.95	106.30
1	A	90	TRP	CE2-CD2-CG	-8.17	100.77	107.30
1	B	157	TRP	CD1-CG-CD2	8.06	112.75	106.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	191	TRP	CE2-CD2-CG	-7.99	100.91	107.30
1	A	157	TRP	CE2-CD2-CG	-7.93	100.96	107.30
1	B	191	TRP	CD1-CG-CD2	7.63	112.41	106.30
1	A	191	TRP	CD1-CG-CD2	7.61	112.39	106.30
1	B	90	TRP	CE2-CD2-CG	-7.61	101.21	107.30
1	B	168	TRP	CE2-CD2-CG	-7.57	101.25	107.30
1	A	90	TRP	CG-CD2-CE3	7.45	140.61	133.90
1	A	168	TRP	CD1-CG-CD2	7.34	112.17	106.30
1	B	157	TRP	CE2-CD2-CG	-6.86	101.82	107.30
1	A	168	TRP	CE2-CD2-CG	-6.83	101.83	107.30
1	A	4	ARG	NE-CZ-NH2	-6.71	116.94	120.30
1	A	4	ARG	NE-CZ-NH1	6.59	123.60	120.30
1	A	157	TRP	CG-CD1-NE1	-6.47	103.63	110.10
1	B	143	VAL	CG1-CB-CG2	-6.45	100.59	110.90
1	B	168	TRP	CG-CD1-NE1	-6.44	103.66	110.10
1	A	90	TRP	CB-CG-CD1	-6.41	118.66	127.00
1	B	12	TRP	CD1-CG-CD2	6.29	111.33	106.30
1	A	191	TRP	CE2-CD2-CG	-6.29	102.27	107.30
1	A	12	TRP	CG-CD2-CE3	6.17	139.45	133.90
1	B	168	TRP	CB-CG-CD1	-6.11	119.06	127.00
1	A	205	ARG	NE-CZ-NH1	6.01	123.30	120.30
1	B	12	TRP	CE2-CD2-CG	-5.98	102.51	107.30
1	A	12	TRP	CE2-CD2-CG	-5.89	102.58	107.30
1	A	12	TRP	CB-CG-CD1	-5.89	119.34	127.00
1	A	90	TRP	CG-CD1-NE1	-5.88	104.22	110.10
1	B	24	LEU	CA-CB-CG	5.76	128.56	115.30
1	A	12	TRP	CD1-CG-CD2	5.64	110.81	106.30
1	B	90	TRP	CG-CD2-CE3	5.58	138.92	133.90
1	B	47	TYR	CB-CG-CD1	-5.52	117.69	121.00
1	B	157	TRP	CG-CD1-NE1	-5.49	104.61	110.10
1	B	90	TRP	CG-CD1-NE1	-5.38	104.72	110.10
1	B	98	ARG	NE-CZ-NH1	5.35	122.97	120.30
1	A	157	TRP	CB-CG-CD1	-5.32	120.08	127.00
1	B	47	TYR	CG-CD2-CE2	-5.28	117.08	121.30
1	A	17	ASP	CB-CG-OD1	5.18	122.96	118.30
1	B	168	TRP	CG-CD2-CE3	5.17	138.55	133.90
1	A	168	TRP	CG-CD1-NE1	-5.12	104.97	110.10
1	B	191	TRP	CG-CD2-CE3	5.08	138.47	133.90
1	B	205	ARG	NE-CZ-NH1	5.05	122.82	120.30
1	B	157	TRP	CG-CD2-CE3	5.01	138.41	133.90

There are no chirality outliers.



All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	208	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	A	1857	0	1865	25	0
1	B	1857	0	1865	27	0
2	A	10	0	4	0	0
2	B	10	0	4	0	0
3	A	140	0	0	3	0
3	B	141	0	0	5	0
All	All	4015	0	3738	52	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 7.

All (52) 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:B:45:SER:HA	1:B:48:LEU:HD22	1.62	0.80
1:B:211:SER:HB2	3:B:848:HOH:O	1.85	0.75
1:A:130:LYS:HA	1:A:167:VAL:HG22	1.69	0.73
1:B:52:ARG:HD3	1:B:52:ARG:O	1.89	0.72
1:B:213:THR:H	1:B:216:ASN:ND2	1.88	0.71
1:B:213:THR:H	1:B:216:ASN:HD21	1.35	0.71
1:B:140:GLU:HB2	3:B:758:HOH:O	1.98	0.63
1:A:8:VAL:HG21	1:A:244:ILE:HA	1.80	0.63
1:A:108:LEU:HG	1:A:112:LYS:HE3	1.82	0.62
1:B:175:THR:HA	3:B:848:HOH:O	2.00	0.62
1:B:143:VAL:O	1:B:147:THR:HG23	2.02	0.60
1:B:169:ALA:HB1	3:B:848:HOH:O	2.02	0.60
1:A:130:LYS:HA	1:A:167:VAL:CG2	2.36	0.55
1:B:127:ILE:HD12	1:B:147:THR:HG22	1.87	0.55
1:B:216:ASN:HD22	1:B:217:CYS:N	2.05	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:141:LYS:NZ	1:B:145:GLU:HG3	2.23	0.52
1:A:194:THR:HG23	1:A:195:HIS:ND1	2.25	0.52
1:B:170:ILE:HD13	1:B:210:GLY:HA2	1.92	0.52
1:B:80:PRO:HB2	1:B:119:GLU:HG3	1.94	0.49
1:A:115:HIS:HD2	3:A:815:HOH:O	1.96	0.48
1:A:125:ALA:HB1	1:A:150:ILE:HD13	1.94	0.48
1:B:165:GLU:HB3	1:B:170:ILE:HD11	1.94	0.48
1:B:105:SER:O	1:B:109:ILE:HG12	2.14	0.47
1:A:213:THR:H	1:A:216:ASN:HD21	1.62	0.46
1:B:127:ILE:HD12	1:B:147:THR:CG2	2.46	0.46
1:B:100:HIS:CE1	1:B:130:LYS:HE2	2.50	0.46
1:B:127:ILE:HG21	1:B:147:THR:HG22	1.98	0.45
1:B:148:LYS:HB2	1:B:148:LYS:HE3	1.73	0.45
1:B:213:THR:N	1:B:216:ASN:HD21	2.11	0.45
1:A:131:LEU:HB2	1:A:168:TRP:HB3	2.00	0.44
1:A:150:ILE:O	1:A:154:VAL:HG23	2.18	0.43
1:A:127:ILE:HD11	1:A:188:LEU:HD21	1.99	0.43
1:A:208:TYR:O	1:A:229:PHE:HA	2.18	0.43
1:A:129:GLU:OE2	1:A:134:ARG:HD2	2.18	0.43
1:A:216:ASN:O	1:A:219:GLU:HG3	2.19	0.43
1:A:165:GLU:HB3	1:A:170:ILE:HD11	1.99	0.43
1:B:33:LEU:HG	1:B:244:ILE:HG21	2.01	0.43
1:A:127:ILE:HG12	3:A:761:HOH:O	2.19	0.42
1:A:56:ASP:OD1	1:A:58:LYS:HE2	2.19	0.42
1:A:164:TYR:CE2	1:A:184:VAL:HG11	2.54	0.42
1:A:134:ARG:NH2	1:A:180:GLN:HG2	2.35	0.42
1:B:189:ARG:NH2	1:B:204:THR:O	2.53	0.42
1:A:189:ARG:NH2	1:A:204:THR:O	2.51	0.42
1:A:67:TYR:HB3	3:A:838:HOH:O	2.20	0.41
1:B:127:ILE:HG22	1:B:146:GLN:HB3	2.03	0.41
1:A:212:VAL:HA	1:A:216:ASN:HD21	1.84	0.41
1:A:213:THR:H	1:A:216:ASN:ND2	2.19	0.41
1:B:115:HIS:HE1	3:B:831:HOH:O	2.04	0.41
1:B:216:ASN:C	1:B:216:ASN:HD22	2.25	0.41
1:A:4:ARG:NE	1:A:189:ARG:NH2	2.69	0.40
1:A:139:THR:O	1:A:143:VAL:HG22	2.21	0.40
1:B:100:HIS:NE2	1:B:130:LYS:HE2	2.36	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	
1	A	243/247 (98%)	234 (96%)	7 (3%)	2 (1%)	24	11
1	B	243/247 (98%)	234 (96%)	9 (4%)	0	100	100
All	All	486/494 (98%)	468 (96%)	16 (3%)	2 (0%)	39	27

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	246	ALA
1	A	196	VAL

### 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	191/192 (100%)	176 (92%)	15 (8%)	15	6
1	B	191/192 (100%)	181 (95%)	10 (5%)	29	17
All	All	382/384 (100%)	357 (94%)	25 (6%)	21	10

All (25) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	58	LYS
1	A	86	ILE
1	A	96	PRO
1	A	98	ARG

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Mol	Chain	Res	Type
1	A	141	LYS
1	A	175	THR
1	A	184	VAL
1	A	188	LEU
1	A	198	ASP
1	A	202	GLN
1	A	205	ARG
1	A	216	ASN
1	A	219	GLU
1	A	231	VAL
1	A	247	LYS
1	B	24	LEU
1	B	33	LEU
1	B	48	LEU
1	B	52	ARG
1	B	86	ILE
1	B	111	GLN
1	B	127	ILE
1	B	130	LYS
1	B	183	GLU
1	B	216	ASN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	115	HIS
1	A	202	GLN
1	A	216	ASN
1	B	53	GLN
1	B	100	HIS
1	B	115	HIS
1	B	179	GLN
1	B	216	ASN

### 5.3.3 RNA ⓘ

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](#)

2 ligands 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	$\# Z  > 2$
2	PGH	A	250	-	9,9,9	0.74	0	10,12,12	1.14	2 (20%)
2	PGH	B	250	-	9,9,9	1.22	0	10,12,12	1.26	1 (10%)

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	PGH	A	250	-	-	0/8/8/8	0/0/0/0
2	PGH	B	250	-	-	0/8/8/8	0/0/0/0

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
2	B	250	PGH	O2-N2-C1	-2.81	115.31	119.56
2	A	250	PGH	C2-C1-N2	-2.08	112.55	116.21
2	A	250	PGH	O4P-P-O3P	2.01	115.02	107.38

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 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 [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

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

### 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

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

### 6.3 Carbohydrates [i](#)

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

### 6.4 Ligands [i](#)

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

### 6.5 Other polymers [i](#)

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