



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 03:25 PM UTC

PDB ID : 5TYE / pdb_00005tye
Title : DNA Polymerase Mu Product Complex, 10 mM Mg²⁺ (60 min)
Authors : Jamsen, J.A.; Wilson, S.H.
Deposited on : 2016-11-19
Resolution : 2.05 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 | : | NOT EXECUTED |
| Xtriage (Phenix) | : | 2.0 |
| EDS | : | NOT EXECUTED |
| Buster-report | : | NOT EXECUTED |
| 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 |

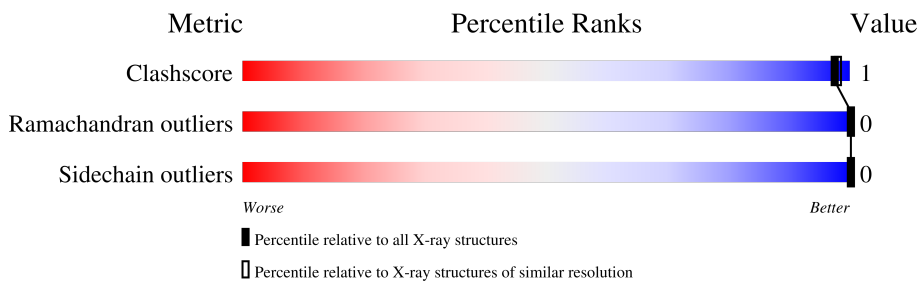
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.05 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 | 2333 (2.04-2.04) |
| Ramachandran outliers | 187476 | 2318 (2.04-2.04) |
| Sidechain outliers | 187428 | 2318 (2.04-2.04) |

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 | A | 356 | |
| 2 | T | 9 | |
| 3 | P | 5 | |
| 4 | D | 4 | |

2 Entry composition

There are 11 unique types of molecules in this entry. The entry contains 3433 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 DNA-directed DNA/RNA polymerase mu.

| Mol | Chain | Residues | Atoms | | | | | ZeroOcc | AltConf | Trace |
|-----|-------|----------|-------|------|-----|-----|----|---------|---------|-------|
| 1 | A | 327 | Total | C | N | O | S | 0 | 19 | 0 |
| | | | 2670 | 1698 | 483 | 479 | 10 | | | |

There are 18 discrepancies between the modelled and reference sequences:

| Chain | Residue | Modelled | Actual | Comment | Reference |
|-------|---------|----------|--------|----------------|------------|
| A | 127 | GLY | - | expression tag | UNP Q9NP87 |
| A | 128 | SER | - | expression tag | UNP Q9NP87 |
| A | 129 | ALA | - | expression tag | UNP Q9NP87 |
| A | 130 | ALA | - | expression tag | UNP Q9NP87 |
| A | 131 | ALA | - | expression tag | UNP Q9NP87 |
| A | ? | - | PRO | deletion | UNP Q9NP87 |
| A | ? | - | GLY | deletion | UNP Q9NP87 |
| A | ? | - | ALA | deletion | UNP Q9NP87 |
| A | ? | - | ALA | deletion | UNP Q9NP87 |
| A | ? | - | VAL | deletion | UNP Q9NP87 |
| A | ? | - | GLY | deletion | UNP Q9NP87 |
| A | ? | - | GLY | deletion | UNP Q9NP87 |
| A | ? | - | SER | deletion | UNP Q9NP87 |
| A | ? | - | THR | deletion | UNP Q9NP87 |
| A | ? | - | ARG | deletion | UNP Q9NP87 |
| A | ? | - | PRO | deletion | UNP Q9NP87 |
| A | ? | - | CYS | deletion | UNP Q9NP87 |
| A | 410 | GLY | PRO | conflict | UNP Q9NP87 |

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

| Mol | Chain | Residues | Atoms | | | | | ZeroOcc | AltConf | Trace |
|-----|-------|----------|-------|----|----|----|---|---------|---------|-------|
| 2 | T | 9 | Total | C | N | O | P | 0 | 0 | 0 |
| | | | 182 | 87 | 36 | 51 | 8 | | | |

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

| Mol | Chain | Residues | Atoms | | | | | ZeroOcc | AltConf | Trace |
|-----|-------|----------|-------|----|----|----|---|---------|---------|-------|
| 3 | P | 5 | Total | C | N | O | P | 0 | 0 | 0 |
| | | | 99 | 49 | 17 | 29 | 4 | | | |

- Molecule 4 is a DNA chain called DNA (5'-D(P*GP*CP*CP*G)-3').

| Mol | Chain | Residues | Atoms | | | | | ZeroOcc | AltConf | Trace |
|-----|-------|----------|-------|----|----|----|---|---------|---------|-------|
| 4 | D | 4 | Total | C | N | O | P | 0 | 2 | 0 |
| | | | 124 | 57 | 24 | 37 | 6 | | | |

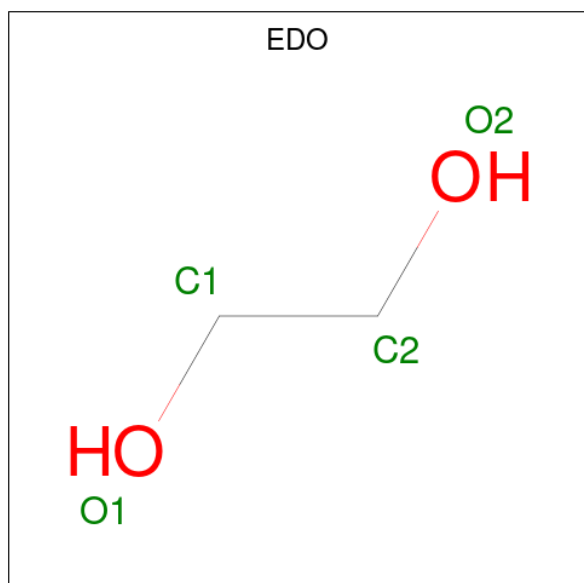
- Molecule 5 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

| Mol | Chain | Residues | Atoms | | ZeroOcc | AltConf |
|-----|-------|----------|-------|----|---------|---------|
| 5 | A | 2 | Total | Mg | 0 | 1 |
| | | | 2 | 2 | | |

- Molecule 6 is SODIUM ION (CCD ID: NA) (formula: Na).

| Mol | Chain | Residues | Atoms | | ZeroOcc | AltConf |
|-----|-------|----------|-------|----|---------|---------|
| 6 | A | 2 | Total | Na | 0 | 1 |
| | | | 2 | 2 | | |

- Molecule 7 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: C₂H₆O₂).



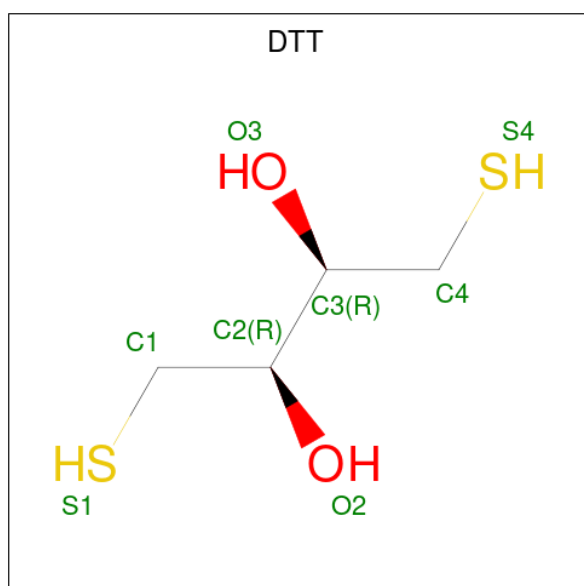
| Mol | Chain | Residues | Atoms | | | ZeroOcc | AltConf |
|-----|-------|----------|-------|---|---|---------|---------|
| 7 | A | 1 | Total | C | O | 0 | 0 |
| | | | 4 | 2 | 2 | | |

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| Mol | Chain | Residues | Atoms | ZeroOcc | AltConf |
|-----|-------|----------|--------------------|---------|---------|
| 7 | A | 1 | Total C O 4 2 2 | 0 | 0 |
| 7 | A | 1 | Total C O 4 2 2 | 0 | 0 |
| 7 | A | 1 | Total C O 4 2 2 | 0 | 0 |
| 7 | A | 1 | Total C O 4 2 2 | 0 | 0 |

- Molecule 8 is 2,3-DIHYDROXY-1,4-DITHIOBUTANE (CCD ID: DTT) (formula: $C_4H_{10}O_2S_2$).



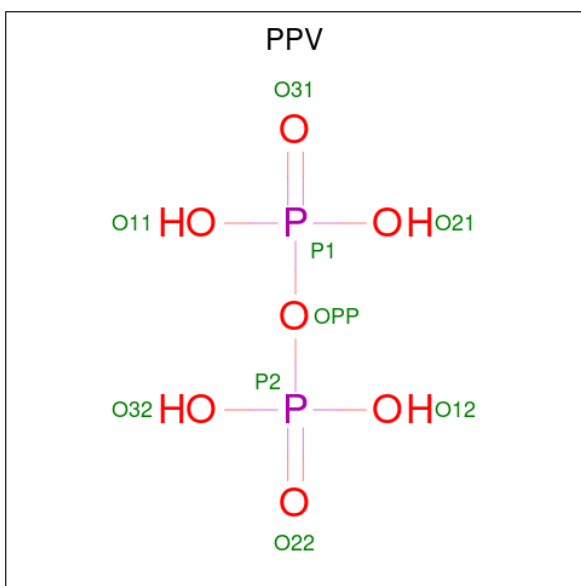
| Mol | Chain | Residues | Atoms | ZeroOcc | AltConf |
|-----|-------|----------|----------------|---------|---------|
| 8 | A | 1 | Total S 1 1 | 0 | 0 |

- Molecule 9 is 4-(2-HYDROXYETHYL)-1-PIPERAZINE ETHANESULFONIC ACID (CCD ID: EPE) (formula: $C_8H_{18}N_2O_4S$).



| Mol | Chain | Residues | Atoms | | | | ZeroOcc | AltConf |
|-----|-------|----------|-------|---|---|---|---------|---------|
| 9 | A | 1 | Total | C | O | S | 0 | 0 |
| | | | 5 | 1 | 3 | 1 | | |

- Molecule 10 is PYROPHOSPHATE (CCD ID: PPV) (formula: $\text{H}_4\text{O}_7\text{P}_2$).



| Mol | Chain | Residues | Atoms | | | ZeroOcc | AltConf |
|-----|-------|----------|-------|---|---|---------|---------|
| 10 | A | 1 | Total | O | P | 0 | 1 |
| | | | 9 | 7 | 2 | | |

- Molecule 11 is water.

| Mol | Chain | Residues | Atoms | | ZeroOcc | AltConf |
|-----|-------|----------|--------------|----------|---------|---------|
| 11 | A | 248 | Total 255 | O 255 | 0 | 17 |
| 11 | T | 31 | Total 32 | O 32 | 0 | 1 |
| 11 | P | 15 | Total 15 | O 15 | 0 | 0 |
| 11 | D | 17 | Total 17 | O 17 | 0 | 4 |

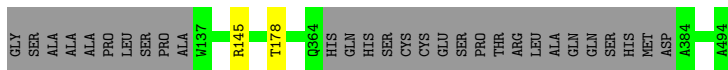
3 Residue-property plots [i](#)

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. 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: DNA-directed DNA/RNA polymerase mu

Chain A:  91% 8%



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

Chain T:  89% 11%




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

Chain P:  100%

There are no outlier residues recorded for this chain.

- Molecule 4: DNA (5'-D(P*GP*CP*CP*G)-3')

Chain D:  75% 25%



4 Data and refinement statistics

EDS was not executed - this section is therefore incomplete.

| Property | Value | Source |
|--|---|-----------|
| Space group | P 21 21 21 | Depositor |
| Cell constants a, b, c, α , β , γ | 60.00Å 68.57Å 110.48Å 90.00° 90.00° 90.00° | Depositor |
| Resolution (Å) | 21.36 – 2.05 | Depositor |
| % Data completeness (in resolution range) | 98.1 (21.36-2.05) | Depositor |
| R_{merge} | 0.10 | Depositor |
| R_{sym} | (Not available) | Depositor |
| $\langle I/\sigma(I) \rangle$ ¹ | 2.45 (at 2.04Å) | Xtriage |
| Refinement program | PHENIX 1.11.1_2575 | Depositor |
| R, R_{free} | 0.186 , 0.228 | Depositor |
| Wilson B-factor (Å ²) | 25.3 | Xtriage |
| Anisotropy | 0.157 | Xtriage |
| L-test for twinning ² | $\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.31$ | Xtriage |
| Estimated twinning fraction | No twinning to report. | Xtriage |
| Total number of atoms | 3433 | wwPDB-VP |
| Average B, all atoms (Å ²) | 27.0 | wwPDB-VP |

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.91% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: EPE, MG, EDO, PPV, NA, DTT

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 | 0.12 | 0/2753 | 0.25 | 0/3727 |
| 2 | T | 0.20 | 0/204 | 0.44 | 0/313 |
| 3 | P | 0.19 | 0/110 | 0.44 | 0/168 |
| 4 | D | 0.16 | 0/137 | 0.36 | 0/205 |
| All | All | 0.13 | 0/3204 | 0.28 | 0/4413 |

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 | 2670 | 0 | 2614 | 2 | 0 |
| 2 | T | 182 | 0 | 102 | 1 | 0 |
| 3 | P | 99 | 0 | 59 | 0 | 0 |
| 4 | D | 124 | 0 | 68 | 1 | 0 |
| 5 | A | 2 | 0 | 0 | 0 | 0 |
| 6 | A | 2 | 0 | 0 | 0 | 0 |
| 7 | A | 20 | 0 | 30 | 0 | 0 |
| 8 | A | 1 | 0 | 0 | 0 | 0 |
| 9 | A | 5 | 0 | 0 | 0 | 0 |

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| Mol | Chain | Non-H | H(model) | H(added) | Clashes | Symm-Clashes |
|-----|-------|-------|----------|----------|---------|--------------|
| 10 | A | 9 | 0 | 0 | 2 | 0 |
| 11 | A | 255 | 0 | 0 | 3 | 0 |
| 11 | D | 17 | 0 | 0 | 0 | 0 |
| 11 | P | 15 | 0 | 0 | 0 | 0 |
| 11 | T | 32 | 0 | 0 | 1 | 0 |
| All | All | 3433 | 0 | 2873 | 5 | 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 1.

All (5) 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:145:ARG:NH2 | 11:A:603[A]:HOH:O | 2.18 | 0.73 |
| 10:A:512[A]:PPV:O22 | 11:A:601:HOH:O | 2.12 | 0.66 |
| 2:T:3:DG:N7 | 11:T:101:HOH:O | 2.34 | 0.53 |
| 10:A:512[A]:PPV:O31 | 11:A:602:HOH:O | 2.17 | 0.42 |
| 1:A:178:THR:OG1 | 4:D:1:DG:N3 | 2.48 | 0.42 |

There are no symmetry-related clashes.

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 | 341/356 (96%) | 333 (98%) | 8 (2%) | 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 | 279/301 (93%) | 279 (100%) | 0 | 100 | 100 |

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

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

| Mol | Chain | Res | Type |
|-----|-------|-----|------|
| 1 | A | 275 | GLN |

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

Mogul was not executed - this section is therefore empty.

5.5 Carbohydrates [i](#)

Mogul was not executed - this section is therefore empty.

5.6 Ligand geometry [i](#)

Mogul was not executed - this section is therefore empty.

5.7 Other polymers [i](#)

Mogul was not executed - this section is therefore empty.

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

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.