



**ZYMO RESEARCH**

*The Beauty of Science is to Make Things Simple*

# INSTRUCTION MANUAL

## **EZ DNA Methylation-Startup™ Kit**

Catalog No. **D5024**

### **Highlights**

- Designed for the first time user requiring a consolidated product to perform DNA methylation analysis.
- A complete system for DNA methylation detection: DNA bisulfite treatment, robust hot start PCR master mix, and a universally methylated human control with primers.
- Ideal for system setup and calibration for DNA methylation detection and analysis.

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Satisfaction of all Zymo Research products is guaranteed. If you should be dissatisfied with this product please call 1-888-882-9682.

## Product Contents

<b>EZ DNA Methylation-Startup™ Kit (Format)</b>	<b>D5024 (1 Kit)</b>	<b>Storage Temperature</b>
<b>EZ DNA Methylation-Direct™ Kit* (Cat. #D5020)</b>	50 Rxn. Kit	Room Temp.
<b>Universal Methylated Human Standard (Cat. #D5011)</b>	20 µl	-20°C
<b>hMLH1 Primer I</b>	20 µl	-20°C
<b>hMLH1 Primer II</b>	20 µl	-20°C
<b>2X ZymoTaq™ PreMix (Cat. #E2003)</b>	2 x 625 µl	-20°C
<b>DNase/RNase-Free H<sub>2</sub>O</b>	2 x 1 ml	Room Temp.

Note - Integrity of kit components is guaranteed for up to one year from date of purchase. Reagents are routinely tested on a lot-to-lot basis to ensure they provide the highest performance and reliability.

\*See protocol included in the kit for product contents and storage guidelines.

## Specifications:

**Application:** Workflow design allows direct sample input for bisulfite treatment of DNA followed by robust PCR amplification of the “converted” DNA for methylation analysis.

**Components:** The EZ DNA Methylation-Startup™ Kit is a two component kit: one is the EZ DNA Methylation-Direct™ Kit (D5020) and the other the Universal Methylated Human Standard (D5011) and 2X ZymoTaq™ PreMix (E2003).

**DNA Recovery:** Typical yields of “bisulfite-converted” DNA are between 80-90%.

**Elution:** DNA can be eluted with ≥ 10 µl M-Elution Buffer or water.

The EZ DNA Methylation-Direct™ Kit is patent pending.

The Polymerase Chain Reaction (PCR) process is covered by U.S. Pat. Nos. 4,683,195 and 4,683,202 assigned to Hoffmann-La Roche. Patents pending in other countries. No license under these patents to use the PCR process is conveyed expressly or by implication to the purchaser by the purchase of Zymo Research's EZ DNA Methylation kits. Further information on purchasing licenses to practice the PCR process can be obtained from the director of Licensing at Applied Biosystems, 850 Lincoln Centre Drive, Foster City, California 94404 or at Roche Molecular Systems, Inc., 1145 Atlantic Avenue, Alameda, California 94501.

Use of Methylation Specific PCR (MSP) is protected by US Patents 5,786,146 & 6,017,704 & 6,200,756 & 6,265,171 and International Patent WO 97/46705. No license under these patents to use the MSP process is conveyed expressly or by implication to the purchaser by the purchase of this product.

Note - ™ Trademarks of Zymo Research Corporation. This product is for research use only and should only be used by trained professionals. Some reagents included with this kit are irritants. Wear protective gloves and eye protection. Follow the safety guidelines and rules enacted by your research institution or facility.

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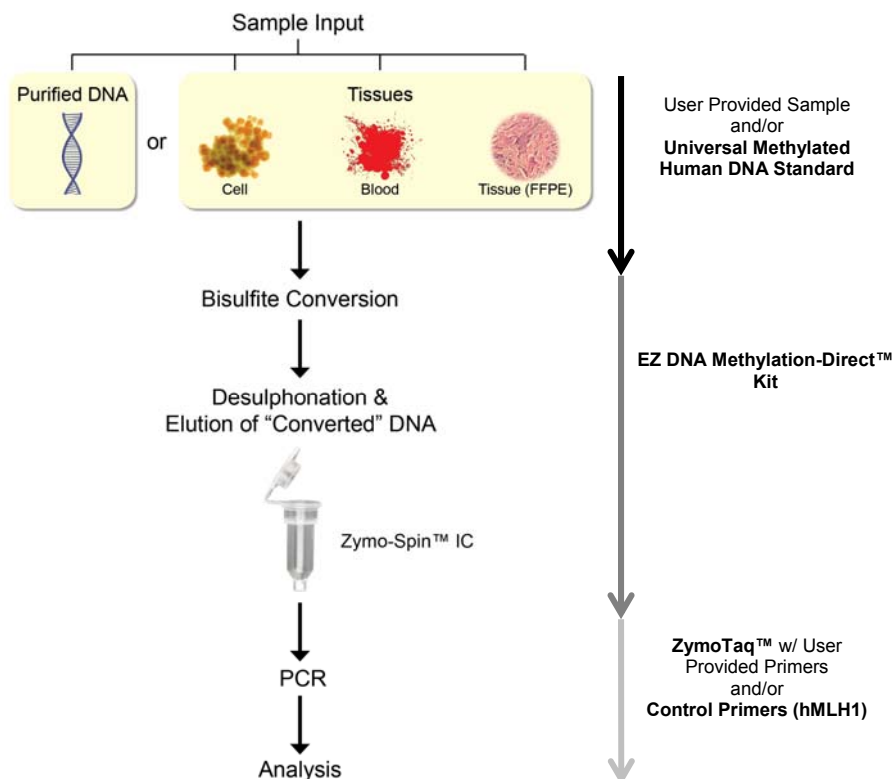
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## DNA Methylation and Bisulfite Treatment

DNA methylation has been shown to play key roles in gene imprinting, embryonic development, X-chromosome gene silencing, cell cycle regulation, and is one of the critical factors in regulating epigenetic control of the genome. In most plants and animals, DNA methylation consists of the addition of a methyl group to the fifth carbon position of the cytosine pyrimidine ring creating 5-methylcytosine via a methyltransferase enzyme. The majority of DNA methylation in mammals occurs in the context of 5'-CpG-3' dinucleotides, which can be used as an epigenetic marker in both normal and diseased conditions.

Currently, the most reliable technique for methylation detection has been the bisulfite conversion method. This technique consists of treating DNA with bisulfite, which causes unmethylated cytosines to be “converted” into uracil while methylated cytosines remain unchanged. With the **EZ DNA Methylation-Startup™ Kit**, purified DNA, blood, or tissue samples can be processed directly. After bisulfite modification, the DNA is then amplified by PCR and the resulting PCR products analyzed either by DNA sequencing or by other methods typically used in determining the methylation status of DNA.

**Diagrammed Workflow of the EZ DNA Methylation-Startup™ Kit**

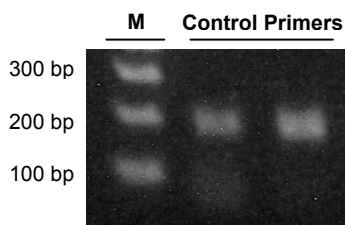


For **Assistance**, please contact Zymo Research Technical Support at 1-888-882-9682 or e-mail [tech@zymoresearch.com](mailto:tech@zymoresearch.com).

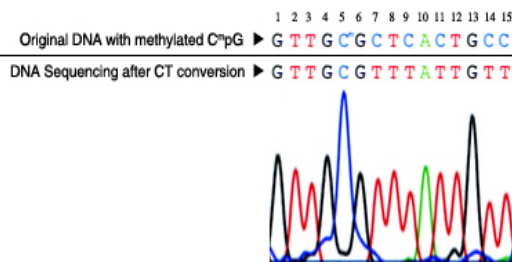
## Product Description

Zymo Research's technologies for bisulfite conversion and DNA methylation detection remain the most popular and cited to date. The **EZ DNA Methylation-Startup™ Kit** is designed to include these technologies for the first time user requiring a consolidated product to perform DNA methylation analysis.

The **EZ DNA Methylation-Startup™ Kit** provides the necessary technologies required for complete bisulfite-conversion of DNA for PCR and methylation analysis. This kit includes bisulfite conversion reagents that allow for direct sampling of blood, cells, and fresh or FFPE tissues without the prerequisite for upstream DNA purification. However, purified DNA can also be bisulfite treated directly. A fully methylated **Universal Methylated Human DNA Standard** is provided together with a special primer set for PCR to control for and assess conversion efficiency. Finally, a unique "hot start" **ZymoTaq™ PreMix** is included for robust amplification of bisulfite-treated DNA.



**Efficient PCR amplification of bisulfite-treated DNA for methylation detection.** The figure shows amplification of a 182 bp product from bisulfite-treated, **Universal Methylated Human DNA Standard** using hMLH1 primers (1 and 2) and **ZymoTaq™ PreMix**. In duplicate, equal amounts of bisulfite-treated DNA (**EZ DNA Methylation-Direct™ Kit**) were used for each PCR. Products were separated in a 2.0% (w/v) agarose/TAE/EtBr gel. Also evident from the image is the low occurrence of primer dimerization and non-specific product formation.



**DNA sequencing results following bisulfite treatment.** DNA with methylated C<sup>m</sup>pG at nucleotide position #5 was processed using the **EZ DNA Methylation™ Kit**. The recovered DNA was amplified by PCR and then sequenced directly. The methylated cytosine at position #5 remained intact while the unmethylated cytosines at positions #7, 9, 11, 14 and 15 were completely converted into uracil following bisulfite treatment and detected as thymine following PCR.

## Protocol

For reagent preparation and DNA bisulfite treatment details, please see the **EZ DNA Methylation-Direct™ Kit** instructions. The following protocol uses the supplied **Universal Methylated Human DNA Standard** as an example and should be used as a guideline for your experimental samples.

### I. **DNA Bisulfite Conversion** (please reference the **EZ DNA Methylation-Direct™ Kit** instruction manual as needed)

1. Dilute the DNA in a PCR tube as outlined below...

2 µl	<b>Universal Methylated Human DNA Standard</b>	(or user supplied sample – see note below)
<u>18 µl</u>	<u>H<sub>2</sub>O</u>	
20 µl	total volume	

**Note:** The maximum input volume of DNA is 20 µl. Alternatively, cells and tissues can be input directly without the prerequisite for DNA purification (reference the **EZ DNA Methylation-Direct™ Kit** protocol).

2. Add 130 µl of freshly prepared **CT Conversion Reagent** to the DNA in the PCR tube. Mix the sample and then centrifuge briefly to ensure no droplets are retained in the cap or the sides of the tube.
3. Proceed with the **EZ DNA Methylation-Direct™ Kit** protocol through to the DNA elution step (i.e., Step 9).

The eluted DNA will be in Elution Buffer (10 mM Tris-HCl, pH 8.5, 0.1 mM EDTA) and can be used for PCR, microarrays, bisulfite sequencing, or other applications.

### II. **PCR Amplification of Bisulfite-Treated DNA**

The following PCR conditions have been optimized for amplification of the **Universal Methylated Human DNA Standard** following bisulfite treatment and should be used as a guideline when setting up your own PCR. The control primers (i.e., hMLH1 I and II) are designed to specifically amplify a 182 bp product. See **Appendix** (page 6) for detailed information regarding the design and use of the **Universal Methylated Human DNA Standard** and **Control Primers**.

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The final concentration of ZymoTaq™ DNA Polymerase in the 1X ZymoTaq™ PreMix is 2 U/50 µl.

1. Set up the following reaction...

12.5 µl	2X ZymoTaq™ PreMix
1 µl	hMLH1 Primer I
1 µl	hMLH1 Primer II
2 µl	Bisulfite-Treated <b>Universal Methylated Human DNA Standard</b>
<u>8.5 µl</u>	<u>ddH<sub>2</sub>O</u>
25 µl	Total Volume

**Note:** The amount of input DNA in the PCR can be increased or decreased as needed. The final concentration of MgCl<sub>2</sub> in the reaction is 1.75 mM. If required, adjust reaction volumes accordingly to optimize the MgCl<sub>2</sub>, primer, and/or template concentrations

2. Use the parameters (temperatures and times below) for amplification of the bisulfite-treated, **Universal Methylated Human DNA Standard**. For amplification of user provided bisulfite-treated DNA, the annealing temperature and extension time should be adjusted according to the primer  $T_m$ s and amplicon size, respectively. We recommend using between 35-40 cycles for most templates. Please refer to **Appendix II** of the **EZ DNA Methylation-Direct™ Kit** protocol for additional PCR and primer design guidelines.

<u>Temperature</u>	<u>Time</u>	
95°C	10 minutes	
94.5°C	30 seconds	} 35-40 cycles
59 °C	30 seconds	
72°C	60 seconds	
2°C	7 minutes	
4°C	"hold"	

The PCR amplified product can be used for gel analysis, TA cloning, restriction endonuclease digestion, microarrays, sequencing, and other downstream molecular applications.

## Appendix

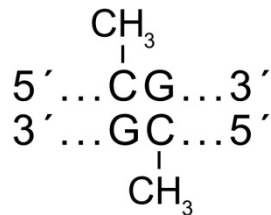
### Universal Methylated Human DNA Standard and Control Primers

#### 1. Universal Methylated Human DNA Standard.

**Source:** DNA derived from a human male. DNA has methylated cytosines (C<sup>5</sup>) at all CG dinucleotide positions.

**Concentration:** 250 ng/μl in TE buffer (10 mM Tris-HCl, 1 mM EDTA, pH 8.0)

**Methylation Site:**



#### 2. Control Primers

Two hMLH1 Control Primers are supplied at a concentration of 20 μM (each) in 20 μl TE buffer. The expected PCR amplicon is **182 bp**, corresponding to nucleotide positions **804 - 986** of the hMLH1 DNA sequence that includes the regions spanned by the primers (see below).

hMLH1 Primer I (sense)

5'-GGAGTGAAGGAGGTTACGGGTAAGT-3'

hMLH1 Primer II (antisense)

5'-AAAACGATAAAACCCTATACCTAATCTATC-3'

**Original sequence of the human MLH1 DNA fragment for bisulfite treatment and PCR amplification (sense strand 5' to 3').** All cytosines in CG dinucleotides (bold) are methylated. Numbers correlate to the nucleotides from the human MLH1 DNA 5' flanking region (GenBank Accession #U83845). Observed CpG/ Expected CpG is > 1 with a 68% total GC content.

```

781 -----
841 gaCGctccac cagggcCGCG CGctCGcCGt cCGccacata cCGctCGtag tattCGtgct
901 cagcctCGta gtggCGcctg aCGtCGCGtt CGCGggtagc taCGatgagg CGgCGacaga
961 ccaggcacag ggccccatCG ccctc
  
```

**Expected Sequence of PCR amplified product following bisulfite conversion (sense strand 5' to 3').**

```

781 -----
841 gaCGttttat tagggtCGCG CGttCGtCGt tCGttatata tCGttCGtag tattCGtggt
901 tagtttCGta gtggCGtttg aCGtCGCGtt CGCGggtagt taCGatgagg CGgCGataga
961 ttaggtatag ggttttatCG ttttt
  
```

## Epigenetics Products From Zymo Research

Product	Description	Kit Size	Cat No. (Format)
<b>Bisulfite Kits for DNA Methylation Detection</b>			
<b>EZ DNA Methylation™ Kit</b>	For the conversion of unmethylated cytosines in DNA to uracil via the <u>chemical-denaturation</u> of DNA and a specially designed CT Conversion Reagent. <i>Fast-Spin</i> technology ensures ultra-pure, converted DNA for subsequent DNA methylation analysis.	50 Rxns. 200 Rxns. 2x96 Rxns. 2x96 Rxns.	<b>D5001</b> (spin column) <b>D5002</b> (spin column) <b>D5003</b> (shallow-well plate) <b>D5004</b> (deep-well plate)
<b>EZ DNA Methylation-Gold™ Kit</b>	For the fast (3 hr.) conversion of unmethylated cytosines in DNA to uracil via <u>heat/chemical-denaturation</u> of DNA and a specially designed CT Conversion Reagent. <i>Fast-Spin</i> technology ensures ultra-pure, converted DNA for subsequent DNA methylation analysis.	50 Rxns. 200 Rxns. 2x96 Rxns. 2x96 Rxns.	<b>D5005</b> (spin column) <b>D5006</b> (spin column) <b>D5007</b> (shallow-well plate) <b>D5008</b> (deep-well plate)
<b>EZ DNA Methylation-Direct™ Kit</b>	Features simple and reliable DNA bisulfite conversion directly from blood, tissue (FFPE/LCM), and cells without the prerequisite for DNA purification in as little as 4-6 hrs. The increased sensitivity of this kit makes it possible to amplify bisulfite converted DNA from as few as 10 cells or 50 pg DNA.	50 Rxns. 200 Rxns. 2x96 Rxns. 2x96 Rxns.	<b>D5020</b> (spin column) <b>D5021</b> (spin column) <b>D5022</b> (shallow-well plate) <b>D5023</b> (deep-well plate)
<b>EZ DNA Methylation-Startup™ Kit</b>	Designed for the first time user requiring a consolidated product to perform DNA methylation analysis. Includes technologies for sample processing, bisulfite treatment of DNA, and PCR amplification of “converted” DNA for methylation analysis.	1 Kit	<b>D5024</b>
<b>EZ Bisulfite DNA Clean-up Kit™</b>	Desulfonation and purification of DNA from any “homebrew” or commercially derived reaction mixture containing bisulfite.	50 Preps. 200 Preps. 2x96 Preps. 2x96 Preps.	<b>D5025</b> (spin column) <b>D5026</b> (spin column) <b>D5027</b> (shallow-well plate) <b>D5028</b> (deep-well plate)
<b>Methylated DNA Standards</b>			
<b>Universal Methylated DNA Standard</b>	pUC19 plasmid DNA having all CpG sites methylated. To be used for the evaluation of bisulfite-mediated conversion of DNA. Supplied with a control primer set.	1 set	<b>D5010</b>
<b>Universal Methylated Human DNA Standard</b>	Human (male) genomic DNA having all CpG sites methylated. To be used for the evaluation of bisulfite-mediated conversion of DNA. Supplied with a control primer set.	1 set	<b>D5011</b>
<b>Universal Methylated Mouse DNA Standard</b>	Mouse (male) DNA having all CpG sites methylated. To be used for the evaluation of bisulfite-mediated conversion of DNA. Supplied with a control primer set.	1 set	<b>D5012</b>
<b>Other...</b>			
<b>ChIP DNA Clean &amp; Concentrator™</b>	Clean and concentrate DNA from any reaction or “crude” preparation in 2 min. A 6 µl minimum elution volume allows for highly concentrated DNA. Designed for samples containing up to 5 µg of DNA.	50 Preps. 50 Preps.	<b>D5201</b> (uncapped column) <b>D5205</b> (capped column)
<b>ZymoTaq™ DNA Polymerase</b>	ZymoTaq™ “hot start” DNA Polymerase is specifically designed for the amplification of “difficult” DNA templates including: bisulfite-treated DNA for methylation detection. The product generates specific amplicons with little or no by-product formation. Available either as a single buffer premix or as a polymerase system with components provided separately.	50 Rxns. 200 Rxns.  50 Rxns. 200 Rxns.	<b>E2001</b> (system) <b>E2002</b> (system)  <b>E2003</b> (premix) <b>E2004</b> (premix)
<b>Anti-5'-Methylcytosine Monoclonal Antibody (clone 10G4)</b>	Mouse monoclonal antibody developed to facilitate the differentiation between methylated and non-methylated cytosines in DNA. Can be used in immunoprecipitation-based procedures including Methylated DNA Immunoprecipitation (MeIP).	50 µg/50 µl 200 µg/200 µl	<b>A3001-50</b> <b>A3001-200</b>