

**INTRODUCTION**

Attachment of polyethylene glycol (PEG) chains to therapeutic biologic agents, a process referred to as PEGylation, prolongs the circulating half-life of the modified protein by slowing proteolytic degradation and by masking it from the immune system. However, it has been reported that repeated injections of PEGylated proteins can induce anti-PEG antibodies that increase the rate of clearance and decrease drug efficacy (accelerated blood clearance, or ABC phenomenon). To aid research in this important area, we have developed a rabbit anti-PEG IgM ELISA kit.

**PRINCIPLE OF THE ASSAY**

The assay uses immobilized mono mPEGylated BSA (20 kDa PEG chain) as the capture antigen (coated on microtiter wells) and horseradish peroxidase (HRP) conjugated anti-rabbit IgM for detection. Serum or plasma samples are diluted and incubated alongside standards in the microtiter wells for 45 minutes. The wells are subsequently washed, and HRP conjugate is added and incubated for 45 minutes. Anti-PEG IgM molecules are sandwiched between immobilized PEG and the detection antibody conjugate. The wells are then washed to remove unbound HRP-labeled antibodies. TMB reagent is added and incubated for 20 minutes at room temperature. This results in the development of a blue color. Color development is stopped by the addition of Stop Solution, changing the color to yellow. Optical density is measured spectrophotometrically at 450 nm. The concentration of anti-PEG IgM is proportional to the absorbance at 450 nm and is derived from a standard curve.

This assay primarily detects antibodies directed against the polyoxyethylene backbone of PEG.

**MATERIALS****Materials provided with the kit:**

- PEG-BSA coated plate (12 x 8-wells) **Store at -20°C**
- Anti-Rabbit IgM HRP Stock (lyophilized) **Store at -20°C**
- Reference Stock<sup>1</sup> (lyophilized) **Store at -20°C**
- 20x HRP PEG Wash: PEGW50-20, 50 ml
- HRP PEG Diluent: PEGD50-1, 50 ml
- TMB: TMB11-1, 11 ml
- Stop Solution: SS11-1, 11 ml

**Materials required but not provided:**

- Pipettors and tips
- Distilled or deionized water
- Polypropylene or glass tubes
- Vortex mixer
- Absorbent paper or paper towels
- Plate incubator/shaker
- Plate washer
- Plate reader capable of measuring at 450 nm.
- Curve fitting software

**STORAGE**

The reference stock, HRP conjugate and the PEG-BSA coated plate should be stored at -20°C. All remaining kit components should be stored at 4°C. The microtiter plate should be kept in a sealed bag with desiccant. Kits will remain stable for six months from the date of purchase provided that the components are stored as described.

**GENERAL INSTRUCTIONS/LIMITATIONS**

1. Please read and understand the instructions thoroughly before using the kit.
2. All reagents should be allowed to reach room temperature (25°C) before use.
3. The wash procedure is critical. Insufficient washing will result in poor precision and falsely elevated absorbance readings.
4. Use only the wash solution and dilution buffer provided with the kit. PEG and PEGylated compounds are found in many buffers conventionally used in ELISA's and cannot be used with this kit.
5. Kits are validated using plate shakers set at 150 rpm and 25°C. Performance of the assay at lower temperatures and/or mixing speeds will likely result in lower absorbance values.
6. Optimal results are achieved if, at each step, reagents are pipetted into the wells of the microtiter plate within 5 minutes.

**WASH SOLUTION**

The wash solution is provided as a 20x stock. Prior to use, dilute the contents of the bottle (50 ml) with 950 ml of distilled or deionized water.

**DILUENT**

The diluent (PEGD50-1) is formulated for measurement PEG antibodies. It is supplied ready to use. DO NOT substitute other buffers.

**STANDARDS**

1. The anti-PEG IgM standard is provided as a lyophilized stock. Reconstitute as described on the vial label to obtain the 100 u/ml standard.
2. Label 7 polypropylene microcentrifuge tubes as 50, 25, 12.5, 6.25, 3.125, 1.563 and 0 u/ml.
3. Dispense 250 µl of diluent into the tubes.
4. Prepare a 50 u/ml standard by diluting and mixing 250 µl of the 100 u/ml standard with 250 µl of diluent in the tube labeled 50 u/ml.
5. Similarly prepare the 25, 12.5, 6.25, 3.125 and 1.563 u/ml standards by serial dilution.

Unused reconstituted stock should be stored frozen at or below -20°C if future use is intended.

<sup>1</sup> Rabbit anti-PEG IgM levels are measured in nominal units and are calibrated using pooled anti-PEG rabbit serum prepared at Life Diagnostics, Inc.

## HRP CONJUGATE

Approximately 15 minutes before needed, reconstitute the lyophilized HRP conjugate as described on the vial label and mix gently. Dilute as described on the vial label to give the working conjugate solution. The reconstituted conjugate stock must be stored at -20°C in a sealed vial if future use is intended.

## SAMPLES

In studies at Life Diagnostics, Inc. we found anti-PEG IgM levels ranging from approximately 1000 u/ml in naïve serum to 350,000 u/ml in serum from rabbits injected with PEG-KLH. Optimum dilutions must be determined empirically. However, we suggest testing each sample at dilutions of 500- and 5000-fold. It is important that the diluent provided with the kit (PEGD50-1) be used for dilution. Do not substitute other buffers.

## PROCEDURE

1. Secure the desired number of coated wells in the holder.
2. Dispense 100 µl of standards and diluted samples into the wells (we recommend testing in duplicate).
3. Incubate on a plate shaker at 150 rpm/25°C for 45 minutes.
4. Aspirate the contents of the microtiter wells and wash the wells five times with 1x wash solution using a plate washer (400 µl/well).
5. Strike the wells sharply onto absorbent paper to remove all residual wash solution.
6. Add 100 µl of diluted HRP conjugate into each well.
7. Incubate on a plate shaker at 150 rpm/25°C for 45-minutes.
8. Wash as detailed above.
9. Dispense 100 µl of TMB into each well.
10. Incubate on a plate shaker at 150 rpm/25°C for 20-minutes.
11. Stop the reaction by adding 100 µl of stop solution to each well.
12. Gently mix. It is important to make sure that all the blue color changes to yellow.
13. Read the optical density at 450 nm with a microtiter plate reader within five minutes<sup>2</sup>.

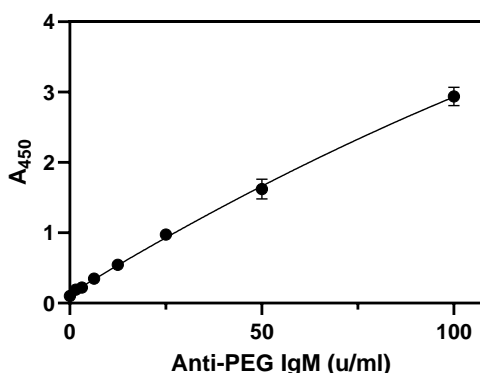
## RESULTS

1. Using curve fitting software, construct a standard curve by plotting absorbance values of the standards versus concentration.
2. Fit the standard curve to an appropriate model (we fit to two-site, total and non-specific binding model) and determine concentration of the diluted samples from the standard curve.
3. Multiply the derived concentration by the dilution factor to determine concentration in the original samples.
4. If the  $A_{450}$  values of samples fall outside the standard curve, samples should be diluted appropriately and re-tested.

## TYPICAL STANDARD CURVE

A typical standard curve with optical density readings at 450nm on the Y-axis against anti-PEG IgM concentrations on the X-axis is shown below. This curve is for the purpose of illustration only and should not be used to calculate unknowns.

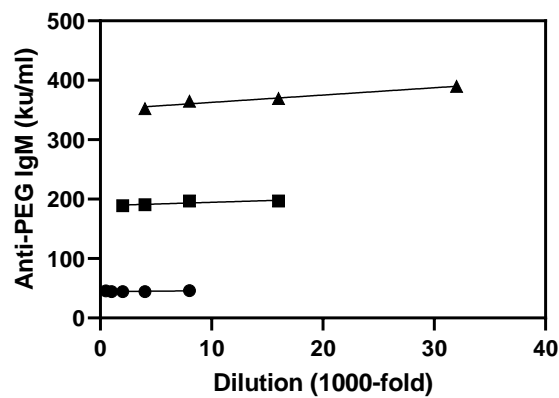
Anti-PEG IgM (u/ml)	$A_{450}$
100	2.939
50	1.623
25	0.976
12.5	0.546
6.25	0.348
3.125	0.221
1.563	0.191
0	0.103



<sup>2</sup> On certain plate readers the  $A_{450}$  value of the high standard may be out of range. If that occurs, absorbance values for all wells may be read at 405 nm instead. Absorbance values will be lower, but this does not affect results.

**ASSAY PERFORMANCE**

**Parallelism:** To assess performance of the assay, three samples containing anti-PEG IgM at concentrations of 44,886, 193,233 and 368,990 u/ml were serially diluted to produce values within the dynamic range of the assay.



**ASSAY UNITS**

At Life Diagnostics, Inc. we have worked with PEG antibodies from mice, rats, monkeys, rabbits, and humans since 2008. Excepting mouse monoclonal antibodies that can be purified under gentle conditions, it has been our experience that elution of PEG antibodies from affinity columns causes significant and indeterminate inactivation. It is therefore very difficult to prepare and quantitate pure functional PEG IgG and IgM antibodies for calibration purposes. For this reason, we decided to use nominal units for measurement. All batches of anti-PEG stock are calibrated to reference serum stored at Life Diagnostics.

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