



# Product Manual

## **cAMP Complete ELISA kit**

Catalog #: ADI-900-163

96 Well Enzyme-Linked Immunosorbent Assay kit

For use with cells, tissue, saliva, serum and culture supernatants

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# Product Manual

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Please read entire booklet before proceeding with the assay.

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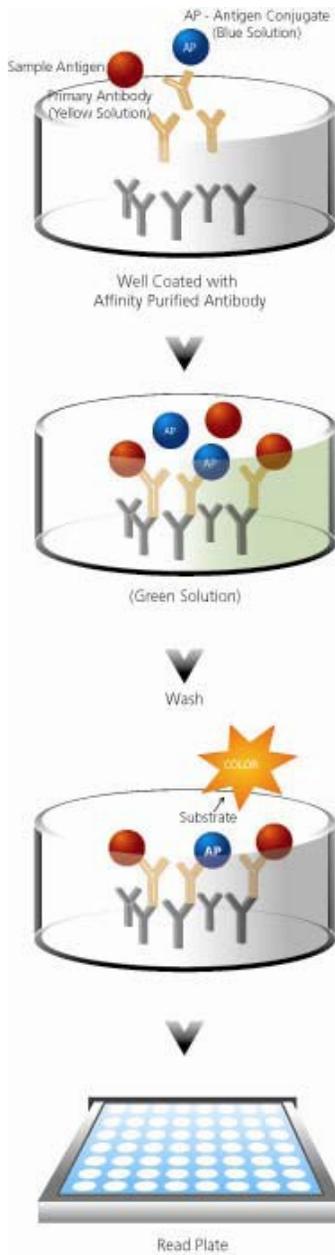


Carefully note the handling and storage conditions of each kit component.



Please contact Enzo Life Sciences Technical Support if necessary.

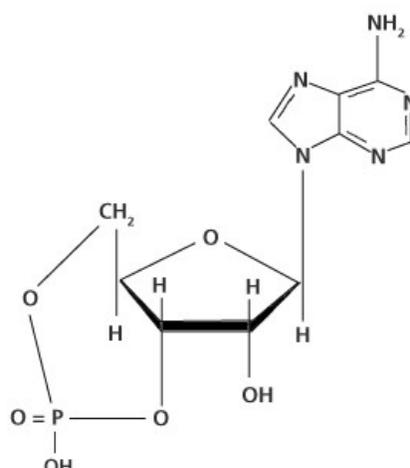
## INTRODUCTION



The cyclic AMP Complete Enzyme-linked Immunosorbent Assay (ELISA) kit is a competitive immunoassay for the quantitative determination of cyclic AMP in cells and tissue treated with HCl, in addition to culture supernatants, saliva, and serum. The optional acetylated assay format provides an approximate 10-fold increase in sensitivity and is ideal for samples with extremely low levels of cAMP. If expected levels of cAMP are unknown, the investigator may evaluate a few samples in the non-acetylated format in order to determine if higher sensitivity is required.

Adenosine 3', 5'-cyclic monophosphate (cyclic AMP; cAMP) is one of the most important "second messengers" involved as a modulator of physiological processes<sup>5</sup>. cAMP is also involved in regulating neuronal, glandular, cardiovascular, immune and other functions<sup>6-9</sup>. A number of hormones are known to activate cAMP through the action of the enzyme adenylate cyclase which converts ATP to cAMP. These hormones include a variety of anterior pituitary peptide hormones such as corticotropin (ACTH), glucagon, calcitonin, thyroid stimulating hormone (TSH), and luteinizing hormone (LH). Because cAMP has been shown to be involved in the cardiovascular and nervous systems, immune mechanisms, cell growth and differentiation, and general metabolism<sup>10-12</sup>, there remains considerable interest in the measurement of intracellular cAMP in tissues and cell cultures. The investigation of cAMP may help to provide a clearer understanding of the physiology and pathology of many disease states.

cyclic AMP



## PRINCIPLE

1. Standards and samples are added to wells coated with a GxR IgG antibody. A blue solution of cAMP conjugated to alkaline phosphatase is then added, followed by a yellow solution of rabbit polyclonal antibody to cAMP.
2. During a simultaneous incubation at room temperature the antibody binds, in a competitive manner, the cAMP in the sample or conjugate. The plate is washed, leaving only bound cAMP.
3. pNpp substrate solution is added. The substrate generates a yellow color when catalyzed by the alkaline phosphatase on the cAMP conjugate.
4. Stop solution is added. The yellow color is read at 405nm. The amount of signal is indirectly proportional to the amount of cAMP in the sample.



Do not mix components from different kit lots or use reagents beyond the expiration date of the kit.



HCl is caustic. Keep tightly capped.



The standard should be handled with care due to the known and unknown effects of the antigen.



Triethylamine and acetic anhydride are lachrymators. **Caution:** corrosive, flammable, and harmful vapor.

## MATERIALS SUPPLIED

1. **Assay Buffer 2**  
27 mL, Component No. 80-0055  
Sodium acetate buffer containing proteins and sodium azide
2. **0.1M HCl**  
27 mL, Component No. 80-0080  
0.1M hydrochloric acid in water
3. **cyclic AMP Standard**  
0.5 mL, Component No. 80-0056  
A solution of 2,000 pmol/mL cAMP
4. **Acetylation Kit**  
2 vials, Component No. 950-001
  - a. **Triethylamine**  
2 mL, Component No. 80-0063
  - b. **Acetic Anhydride**  
1 mL, Component No. 80-0064
5. **Goat anti-Rabbit IgG Microtiter Plate**  
One plate of 96 wells, Component No. 80-0060  
A clear plate of break-apart strips coated with a goat anti-rabbit polyclonal antibody



Avoid contamination by endogenous alkaline phosphatase. Do not expose reagents or supplies to bare skin.



Activity of conjugate is affected by concentrations of chelators > 10mM (such as EDTA and EGTA).



Activity of conjugate is affected by nucleophiles such as azide, cyanide, and hydroxylamine.



Stop solution is caustic. Keep tightly capped.

## 6. Neutralizing Reagent

5 mL, Component No. 80-1475

## 7. cAMP Antibody

5 mL, Component No. 80-0604

A yellow solution of rabbit polyclonal antibody to cAMP

## 8. cAMP Conjugate

5 mL, Component No. 80-0053

A blue solution of cAMP conjugated to alkaline phosphatase

## 9. Wash Buffer Concentrate

27 mL, Component No. 80-1286

Tris buffered saline containing detergents

## 10. pNpp Substrate

20 mL, Component No. 80-0075

A solution of p-nitrophenyl phosphate

## 11. Stop Solution

5 mL, Component No. 80-0247

A solution of trisodium phosphate in water

## 12. cAMP Complete Assay Layout Sheet

1 each, Component No. 30-0243

## 13. Plate Sealer, 1 each, Component No. 30-0012

## STORAGE

All components of this kit, **except the Conjugate and Standard**, are stable at 4°C until the kit's expiration date. The Conjugate and Standard **should** be stored at -20°C upon receipt.

## ADDITIONAL MATERIALS NEEDED

1. Deionized or distilled water
2. Precision pipets for volumes between 5 µL and 1,000 µL
3. Repeater pipet for dispensing 50 µL and 200 µL
4. Disposable beakers for diluting buffer concentrates
5. Graduated cylinders
6. Microplate shaker
7. Lint-free paper toweling for blotting
8. Microplate reader capable of reading at 405 nm



Reagents require separate storage conditions.

9. Triton X-100 (optional for sample preparation)
10. Liquid nitrogen, mortar & pestle, and concentrated HCl (optional – for tissue samples)



If buffers other than those provided are used in the assay, the end-user must determine the appropriate dilution and assay validation.

## SAMPLE HANDLING

Treatment of cells and tissue with HCl will stop endogenous phosphodiesterase activity and allow for the direct measurement of these samples in the assay without evaporation or further processing. Recommended treatment protocols follow. Samples containing rabbit IgG will interfere with the assay. EDTA plasma may precipitate during acetylation.

Biological fluids, such as serum and saliva, should be diluted in Assay Buffer 2 and run directly in the assay. A minimum 1:10 dilution is required for serum and a 1:4 dilution for saliva (see Sample Recoveries section). These are the minimum dilutions required to remove matrix interference of these samples.

Culture supernatants may be run directly in the assay provided the same non-conditioned media is used as the standard diluent.

Please note that some samples may contain high levels of cAMP and additional dilution may be required. Samples with low levels of cAMP may be assayed in the acetylated format or the samples may be concentrated.



Samples must be stored at or below -20°C to avoid loss of bioactive analyte. Avoid repeated freeze/ thaw cycles.

## SAMPLE RECOVERIES

cAMP standard was spiked into the following matrices diluted with Assay Buffer 2 and measured in the kit. The results were as follows:

Sample	Non-Acetylated Format		Acetylated Format	
	% Recovery	Recommended Dilution	% Recovery	Recommended Dilution
Tissue Culture Media	96.2%	None	101.2%	None
Human Serum	101.5%	1:10	117.8%	1:64
Human Saliva	103.2%	1:4	94.9%	1:4

0.1 M HCl should not be used to dilute culture supernatants serum, or saliva samples.

## PROTOCOL FOR CELL LYSATES

The concentration of cells used must be optimized for the specific cell line and treatment conditions. Cells may be grown in typical containers such as Petri dishes, culture plates (e.g., 48-well, 12-well, or 96-well), culture flasks, etc. Some cells are particularly hardy (e.g., bacteria) and may require the addition of 0.1 to 1% Triton X-100 to the 0.1M HCl for enhanced lysis. If Triton X-100 is added to samples it should also be added to the standard dilution as a modest increase in optical density may occur.

1. Pellet **suspension cells** and aspirate the media. Treat cells with 0.1M HCl. A general starting concentration of  $1 \times 10^6$  cells per mL of 0.1M HCl is recommended. Remove the media from **adherent cells** and add enough 0.1M HCl to cover the bottom of the plate. Avoid over-diluting the sample with an excessive volume of HCl. Please note that the culture media may be saved and assayed separately, if desired.
2. Incubate the cells in 0.1M HCl for 10 minutes at room temperature.
3. Inspect the cells under a microscope to ensure uniform lysis. Continue incubating for an additional 10 minutes, if necessary.
4. Centrifuge  $\geq 600 \times g$  to pellet the cellular debris.
5. The supernatant may be assayed immediately or stored frozen for later analysis.

**Note: Standards must be diluted in 0.1 M HCl and Neutralizing Reagent used.**

## PROTOCOL FOR TISSUE SAMPLES

Two options are available for tissue samples. Protocol 1 is more straightforward and user-friendly. Protocol 2 is available if samples require concentration.

### Protocol 1: Treatment with 0.1 M HCl

1. After collection, tissue samples should be flash frozen in liquid nitrogen. If analysis cannot be carried out immediately, store tissue at  $-80^{\circ}\text{C}$ .
2. Grind frozen tissue to a fine powder under liquid nitrogen in a stainless steel mortar.
3. When liquid nitrogen has evaporated, weigh the frozen tissue and homogenize in 10 volumes of 0.1M HCl (e.g., 0.1 g of tissue should be homogenized in 1 mL of 0.1M HCl).
4. Centrifuge  $\geq 600 \times g$  to pellet the debris (~10 minutes).
5. The supernatant may be further diluted in the 0.1M HCl provided and run directly in the assay or stored frozen for later analysis.

**Note: Standards must be diluted in 0.1 M HCl and Neutralizing Reagent used.**

### Protocol 2: TCA / Ether Extraction

1. After collection, tissue samples should be flash frozen in liquid nitrogen. If analysis cannot be carried out immediately, store tissue at  $-80^{\circ}\text{C}$ .
2. Grind frozen tissue to a fine powder under liquid nitrogen in a stainless steel mortar.
3. When liquid nitrogen has evaporated, weigh the frozen tissue and homogenize in 10 volumes of cold 5% TCA in a glass-Teflon tissue grinder.
4. Centrifuge at  $\geq 600 \times g$  to pellet the debris (~10 minutes).
5. Extract the supernatant with 3 volumes of water-saturated ether.
6. Dry the aqueous extracts and reconstitute in at least 250  $\mu\text{L}$  Assay Buffer 2 (to allow for duplicate measures).

**Note: standards must be diluted in Assay Buffer 2, no Neutralizing Reagent is used.**



Glass or polypropylene tubes may be used for standard preparation. Avoid polystyrene.

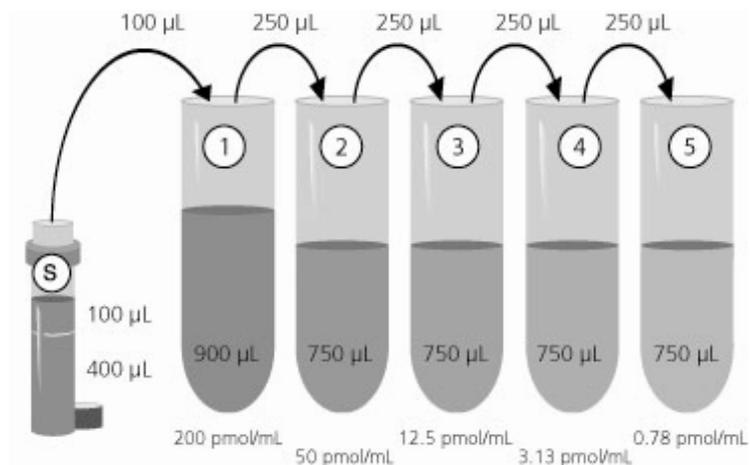
## REAGENT PREPARATION

### 1. Wash Buffer

Prepare the wash buffer by diluting 5 mL of the supplied Wash Buffer Concentrate with 95 mL of deionized water. This can be stored at room temperature until the kit expiration, or for 3 months, whichever is earlier.

### 2. cAMP Standard, non-acetylated format

Three diluent options are available for the preparation of the standard curve, NSB, and Bo wells. For cell lysates and tissue samples prepared in 0.1M HCl, use the supplied 0.1M HCl as the standard diluent. Use Assay Buffer 2 for the standard diluent when the sample is serum or saliva. For culture supernate samples, use the same non-conditioned media for the standard diluent.



Allow the 2,000 pmol/mL standard stock to warm to room temperature. Label five 12mm x 75mm tubes #1 through #5. Pipet 900 µL of the appropriate sample diluent into tube #1. Pipet 750 µL of the appropriate sample diluent into tubes #2 through #5. Add 100 µL of the 2,000 pmol/mL standard stock into tube #1 and vortex thoroughly. Add 250 µL of tube #1 to tube #2 and vortex thoroughly. Add 250 µL of tube #2 to tube #3 and vortex thoroughly. Continue this for tubes #4 through #5.

**Diluted standards should be used within 60 minutes of preparation.** The concentrations of cAMP in the tubes are labeled above.



Triethylamine and acetic anhydride are lachrymators. **Caution:** corrosive, flammable, and harmful vapor.



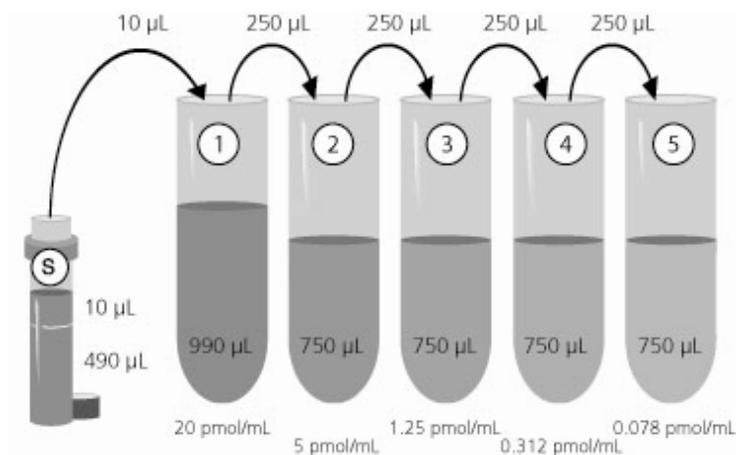
Glass or polypropylene tubes may be used for standard preparation. Avoid polystyrene.

### 3. Acetylation Reagent (optional)

Prepare the Acetylating Reagent by adding 0.5 mL of Acetic Anhydride to 1 mL of Triethylamine. Note that this volume is sufficient to add to 30 mL of diluted standards and samples. Use the prepared reagent within **60 minutes** of preparation. Discard any unused portion of the Acetylating Reagent.

### 4. cAMP Standard, acetylated format (optional)

Three diluent options are available for the preparation of the standard curve, NSB, and Bo wells. For cell lysates and tissue samples prepared in 0.1M HCl, use the supplied 0.1M HCl as the standard diluent. Use Assay Buffer 2 for the standard diluent when the sample is serum or saliva. For culture supernate samples, use the same non-conditioned media for the standard diluent.



Allow the 2,000 pmol/mL standard stock to warm to room temperature. Label five 12mm x 75mm tubes #1 through #5. Pipet 990 µL of the appropriate sample diluent into tube #1. Pipet 750 µL of the appropriate sample diluent into tubes #2 through #5. Add 10 µL of the 2,000 pmol/mL standard stock into tube #1 and vortex thoroughly. Add 250 µL of tube #1 to tube #2 and vortex thoroughly. Add 250 µL of tube #2 to tube #3 and vortex thoroughly. Continue this for tubes #4 through #5.

Acetylate all **standards and samples** by adding 10 µL of the Acetylating Reagent for each 200 µL of the standard or sample. Add the Acetylating Reagent directly to the diluted standard or sample and vortex immediately after the addition of the Acetylating Reagent.

Label one 12mm x 75mm tube as the Bo/NSB tube.

Pipet 1 mL of the 0.1M HCl into this tube. Add 50  $\mu$ L of the Acetylating Reagent to the Bo/NSB tube and use in Steps 2 and 3 of the Assay Procedure.

**The acetylated standards and samples should be used within 30 minutes of preparation.** The concentrations of cAMP in the tubes are labeled above.

## ASSAY PROCEDURE



Bring all reagents to room temperature for at least 30 minutes prior to opening.



All standards and samples should be run in duplicate.



Pre-rinse each pipet tip with reagent. Use fresh pipet tips for each sample, standard, and reagent.



Pipet the reagents to the sides of the wells to avoid possible contamination.

Refer to the Assay Layout Sheet to determine the number of wells to be used. Remove the wells not needed for the assay and return them, with the desiccant, to the mylar bag and seal. Store unused wells at 4°C.

Note: If the acetylated format of the assay is to be run, all standards, samples, and the diluent for the NSB and Bo wells must be acetylated as per the instructions in the Reagent Preparation section. Acetylated standards and samples must be used within 30 minutes.

1. If using samples prepared in 0.1M HCl, pipet 50  $\mu$ L of Neutralizing Reagent into each well except the Total Activity (TA) and Blank wells. Do not add Neutralizing Reagent for the other sample diluent options.
2. Pipet 100  $\mu$ L of the appropriate standard diluent (Assay Buffer 2, 0.1M HCl, or non-conditioned culture media) into the NSB (non-specific binding) and Bo (0 pmol/mL standard) wells.
3. Add 50  $\mu$ L of standard diluent to the NSB wells.
4. Pipet 100  $\mu$ L of Standards #1 through #5 to the bottom of the appropriate wells.
5. Pipet 100  $\mu$ L of the samples to the bottom of the appropriate wells.
6. Pipet 50  $\mu$ L of the blue conjugate into each well except the TA and Blank wells.
7. Pipet 50  $\mu$ L of the yellow antibody into each well except the Blank, TA, and NSB wells.

**Note:** Every well used should be green in color except the NSB wells which should be blue. The Blank and TA wells are empty at this point and have no color.

8. Seal the plate. Incubate for 2 hours on a plate shaker (~500 rpm) at room temperature.



Prior to the addition of the antibody, conjugate and substrate, ensure there is no residual wash buffer in the wells. Remaining wash buffer may cause variation in assay results.

9. Empty the contents of the wells and wash by adding 400  $\mu\text{L}$  of wash buffer to every well. Repeat 2 more times for a total of 3 washes. After the final wash, empty or aspirate the wells and firmly tap the plate on a lint free paper towel to remove any remaining wash buffer.
10. Pipet 5  $\mu\text{L}$  of the blue conjugate to the TA wells.
11. Add 200  $\mu\text{L}$  of the substrate solution into each well.
12. Incubate for 1 hour at room temperature without shaking.
13. Pipet 50  $\mu\text{L}$  stop solution into each well.
14. After blanking the plate reader against the substrate blank, read optical density at 405 nm. If plate reader is not capable of adjusting for the blank, manually subtract the mean OD of the substrate blank from all readings.



Make sure to multiply sample concentrations by the dilution factor used during sample preparation.

## CALCULATION OF RESULTS

Several options are available for the calculation of the concentration of cAMP in the samples. We recommend that the data be handled by an immunoassay software package utilizing a 4 parameter logistic (4PL) curve fitting program. Assay Blaster! Assay Analysis software (Cat. #ADI-28-0002) is an easy-to-use and cost effective program that provides the options of point-to-point, 4PL and 5PL curve fitting options.

Samples with concentrations outside of the standard curve range will need to be re-analyzed using a different dilution.

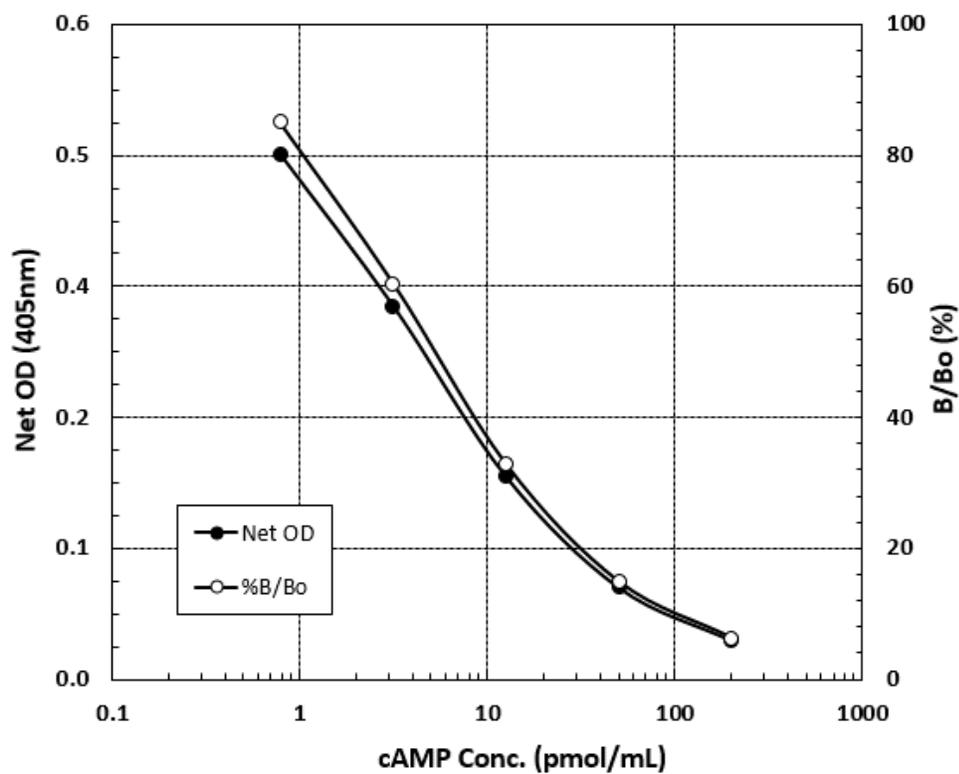
To normalize for protein content, divide the resulting picomole per mL determinations ( $\text{pmol/mL}$ ) by the total protein concentration ( $\text{mg/mL}$ ) in each sample. This is expressed as  $\text{pmol cAMP per mg of total protein}$ .

## TYPICAL RESULTS

The results shown below are for illustration only and should not be used to calculate results from another assay.

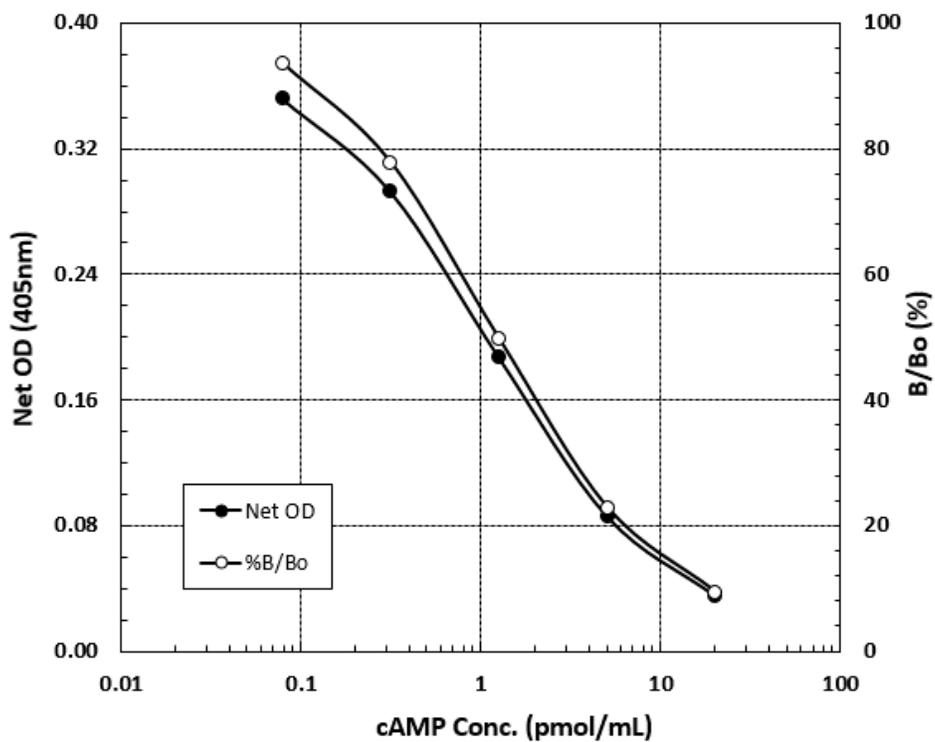
### Non-acetylated assay format in Assay Buffer 2

Sample	Mean OD (- Blank)	Average Net OD	Percent Bound	cAMP (pmol/mL)
Blank (mean)	(0.079)	---	---	---
TA	1.656	1.657	---	---
NSB	-0.001	0.000	---	---
Bo	0.565	0.566	100%	0
S1	0.035	0.036	6.3%	200
S2	0.083	0.084	14.9%	50
S3	0.185	0.186	32.8%	12.5
S4	0.341	0.342	60.5%	3.125
S5	0.480	0.481	85.1%	0.781
Unknown 1	0.129	0.130	23.0%	23.90
Unknown 2	0.316	0.317	56.0%	3.86



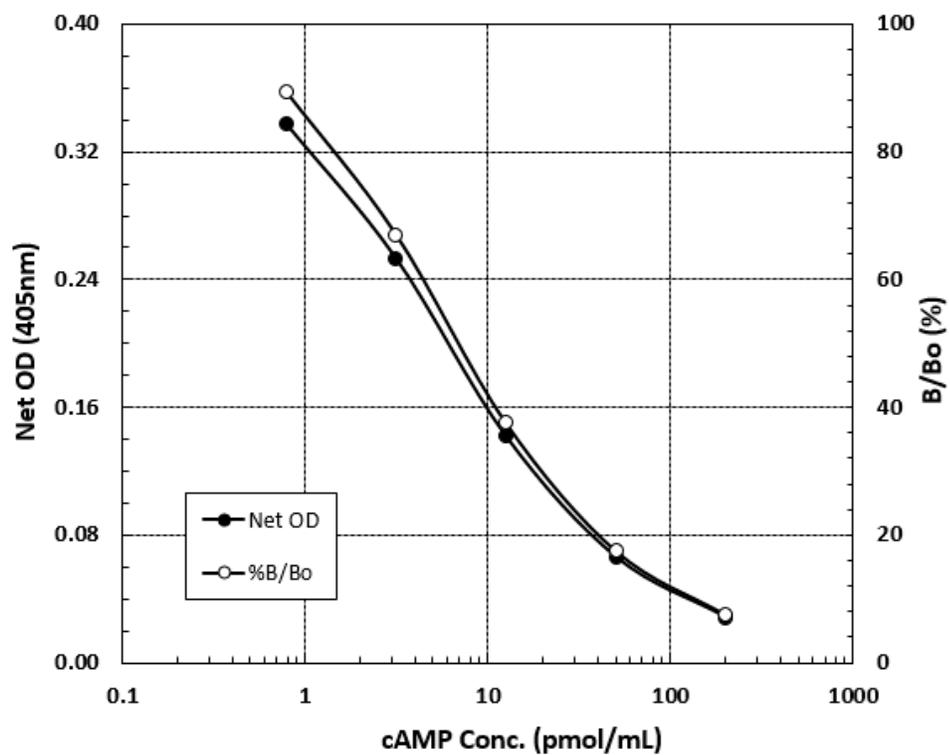
## Acetylated assay format in Assay Buffer 2

Sample	Mean OD (- Blank)	Average Net OD	Percent Bound	cAMP (pmol/mL)
Blank (mean)	(0.079)	---	---	---
TA	1.528	1.527	---	---
NSB	0.001	0.000	---	---
Bo	0.377	0.376	100%	0
S1	0.036	0.035	9.4%	200
S2	0.087	0.086	22.9%	50
S3	0.188	0.187	49.9%	12.5
S4	0.294	0.293	77.9%	3.125
S5	0.353	0.352	93.7%	0.781
Unknown 1	0.145	0.144	38.3%	2.12
Unknown 2	0.297	0.296	78.8%	0.30



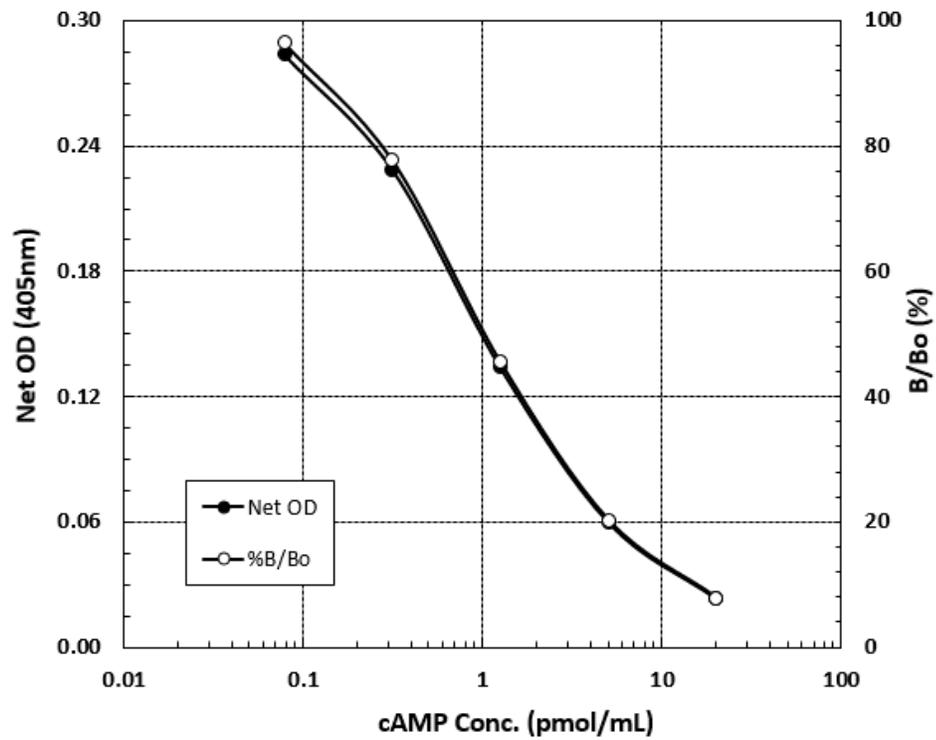
## Non-acetylated assay format in 0.1 M HCl

Sample	Mean OD (- Blank)	Average Net OD	Percent Bound	cAMP (pmol/mL)
Blank (mean)	(0.075)	---	---	---
TA	1.456	1.455	---	---
NSB	0.001	0.000	---	---
Bo	0.379	0.378	100%	0
S1	0.029	0.028	7.5%	200
S2	0.067	0.066	17.5%	50
S3	0.143	0.142	37.6%	12.5
S4	0.254	0.253	67.1%	3.125
S5	0.339	0.338	89.5%	0.781
Unknown 1	0.113	0.112	29.7%	19.71
Unknown 2	0.238	0.237	62.8%	3.81



## Acetylated assay format in 0.1 M HCl

Sample	Mean OD (- Blank)	Average Net OD	Percent Bound	cAMP (pmol/mL)
Blank	(0.092)	---	---	---
TA	1.361	1.362	---	---
NSB	-0.001	0.000	---	---
Bo	0.293	0.294	100%	0
S1	0.022	0.023	7.9%	20
S2	0.059	0.060	20.3%	5
S3	0.133	0.134	45.5%	1.25
S4	0.228	0.229	77.7%	0.312
S5	0.283	0.284	96.5%	0.078
Unknown 1	0.095	0.096	32.6%	2.31
Unknown 2	0.183	0.184	62.5%	0.62



## PERFORMANCE CHARACTERISTICS

### Specificity

The cross reactivities for a number of related compounds were determined by diluting the cross reactants in the kit assay buffer at a concentration of ten times the high standard. These samples were then measured in the assay.

Compound	Cross Reactivity
cAMP	100%
AMP	<0.33%
ATP	<0.12%
cGMP	<0.001%
GMP	<0.001%
GTP	<0.001%
cUMP	<0.001%
CTP	<0.001%

### Sensitivity

#### Assay Buffer 2

The sensitivity of the assay, defined as the concentration of cAMP measured at 2 standard deviations from the mean of 16 zeros along the standard curve, was determined to be 0.30 pmol/mL in the non-acetylated assay format and 0.039 pmol/mL in the acetylated assay format.

#### 0.1M HCl

The sensitivity of the assay, defined as the concentration of cAMP measured at 2 standard deviations from the mean of 16 zeros along the standard curve, was determined to be 0.39 pmol/mL in the non-acetylated assay format and 0.037 pmol/mL in the acetylated assay format.

### Linearity

A buffer sample containing cAMP was serially diluted 1:2 in the kit assay buffer and measured in the assay. The results are shown in the table below.

#### Non-acetylated

Dilution	Expected (pmol/mL)	Observed (pmol/mL)	Recovery (%)
Neat	---	49.2	---
1:2	24.6	23.1	94%
1:4	12.3	13.7	112%
1:8	6.15	6.9	112%
1:16	3.07	3.4	111%

## Acetylated

Dilution	Expected (pmol/mL)	Observed (pmol/mL)	Recovery (%)
Neat	---	5.42	---
1:2	2.71	2.86	106%
1:4	1.36	1.23	91%
1:8	0.68	0.51	75%
1:16	0.34	0.28	83%

A 0.1M HCl sample containing cAMP was serially diluted 1:2 in the 0.1M HCl diluent and measured in the assay. The results are shown in the table below.

## Non-acetylated

Dilution	Expected (pmol/mL)	Observed (pmol/mL)	Recovery (%)
Neat	---	15.44	---
1:2	7.72	8.24	107%
1:4	3.86	3.67	95%
1:8	1.93	2.32	120%

## Acetylated

Dilution	Expected (pmol/mL)	Observed (pmol/mL)	Recovery (%)
Neat	---	3.41	---
1:2	1.70	2.03	119%
1:4	0.85	0.95	111%
1:8	0.43	0.49	115%

## Precision

Intra-assay precision was determined by assaying 20 replicates of three buffer controls containing cAMP in a single assay.

### Non-Acetylated Format

In Assay Buffer 2	
pmol/mL	%CV
1.18	10.5
5.96	2.5
18.6	2.9

In 0.1M HCl	
pmol/mL	%CV
1.24	8.9
6.31	4.3
35.92	8.3

### Acetylated Format

In Assay Buffer 2	
pmol/mL	%CV
0.40	7.4
0.90	6.8
5.58	7.7

In 0.1M HCl	
pmol/mL	%CV
0.679	4.6
3.58	8.4

Inter-assay precision was determined by measuring buffer controls of varying cAMP concentrations in multiple assays over several days.

### Non-Acetylated Format

In Assay Buffer 2	
pmol/mL	%CV
1.13	13.7
4.95	11.2
19.18	8.4

In 0.1M HCl	
pmol/mL	%CV
1.18	13.1
5.53	4.2
30.36	11.6

### Acetylated Format

In Assay Buffer 2	
pmol/mL	%CV
0.46	11.2
0.98	11.2
4.75	7.9

In 0.1M HCl	
pmol/mL	%CV
1.29	13.6
5.62	7.8

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# Product Manual

## NOTES



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