

**CultreCoat<sup>®</sup> 96 Well *In Vitro* Vascular  
Permeability Assay**

Catalog# 3475-096-K

96 Samples

**CultreCoat<sup>®</sup> 96 Well *In Vitro*  
Vascular Permeability Assay**

**Reagent kit for investigating vascular  
permeability.**

**96 samples**

**Catalog #: 3475-096-K**

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## I. Quick Reference Procedure for CultreCoat<sup>®</sup> 96 Well Vascular Permeability Assay (Cat# 3475-096-K):

Read through the complete Instructions for Use prior to using this kit.

### Prior to Day 1

1. Culture cells per manufacturer's recommendation; adherent cells should be cultured to no more than 90% confluence. Cell seeding density may vary based on cell type (100,000 cells per well required for HUVECs), so plan accordingly. Cells may be pre-treated during culture if necessary.

### Day 1

2. Rehydrate collagen I-coated membranes by adding 50 µl of complete cell culture medium to the upper chamber, and incubate at 37 °C in CO<sub>2</sub> incubator for 2 hours.
3. Harvest cells.
4. Centrifuge cells at 200 x g for 3 minutes; then count and resuspend at 2 x 10<sup>6</sup> cells/ml in a complete culture medium.
5. Add 50 µl of cells per well to top chamber (100,000 cells/well).
6. Using access port, add 150 µl of complete culture medium per well to bottom chamber.
7. Incubate chamber at 37 °C in CO<sub>2</sub> incubator for 72 hours or until a monolayer is formed.

### Day 4

8. If serum-starvation is not required, proceed to step 9. If it is needed, then carefully aspirate media from the top and bottom chambers. Quickly add 50 µl of starvation medium (basal culture medium containing 0.5% FBS), and add 150 µl starvation medium to the bottom chamber. Do not allow cells to dry. Incubate for 6 to 24 hours.
9. If not testing compounds, then proceed to step 10. If testing compounds, then carefully aspirate media from the top and bottom chambers. Prepare treatment medium (containing test compounds, with or without serum). Quickly add 50 µl of treatment medium to the top chamber, and add 150 µl of treatment medium to the bottom chamber. Do not allow cells to dry. Incubate at 37 °C in a CO<sub>2</sub> incubator as desired.
10. Prepare FITC-Dextran (see Section VI.2.).
11. Add 150 µl of basal medium to the black assay chamber.
12. Carefully aspirate media from the top and bottom chambers, and quickly transfer the top chamber to the black assay chamber.
13. Add 50 µl of FITC-Dextran to the top chamber, and incubate at 37 °C in a CO<sub>2</sub> incubator for 5 minutes.
14. To stop the reaction, remove top chamber, and read plate at 485 nm excitation, 520 nm emission.

## II. Background

The vascular endothelium is the thin monolayer of cells that lines blood vessels and provides a network for the exchange of biological materials such as gases, nutrients, and metabolic waste throughout the body. The endothelium exhibits a selective barrier function between the vessel lumen and the surrounding tissues which controls this exchange. There are many vasoactive cytokines and growth factors that function in regulating the degree of vascular permeability, such as interleukin 1 alpha and beta<sup>1</sup>, TNF-alpha<sup>2</sup>, IFN gamma<sup>1</sup>, hepatocyte growth factor (HGF)<sup>3</sup>, and vascular endothelial growth factor (VEGF)<sup>4</sup>. There are also several systemic diseases associated with disruption of vascular permeability, such as cancer<sup>4</sup>, diabetes<sup>3</sup>, heart disease<sup>3</sup>, stroke<sup>5</sup>, hypertension<sup>5</sup>, and arthritis<sup>6</sup>.

Trevigen's **CultreCoat<sup>®</sup> 96 Well Vascular Permeability Assay** was created to accelerate the screening process for signal transduction pathway modulators and compounds that influence vascular permeability. This assay offers a flexible, standardized, high-throughput format for quantitating the degree to which genes or compounds can influence the maintenance of endothelial cell-to-cell adhesion.

This assay employs a simplified Boyden chamber design with a one micron polyethylene terephthalate (PET) membrane coated with collagen I. Ports within the migration chamber (top) allow access to the assay chamber (bottom) without dismantling the device. This design is easier to use, prevents contamination, and is adaptable for robotic high throughput systems. The assay chamber may be directly analyzed in a 96 well plate reader, eliminating transfer steps that introduce additional variability to the assay.

Since different cell lines may exhibit variation in size, adhesive properties, and proliferation rates, cell seeding densities and culture periods may require some optimization (the current protocol is optimized using human umbilical vein endothelial cells (HUVECs)).

Detection of vascular permeability is quantified using FITC-Dextran. The confluent cell monolayer forms a barrier through cell-cell adhesion mechanisms such as junctions (adherens, tight, and gap) and desmosomes, and this barrier restricts FITC-Dextran to the top chamber. Disruption of these cell-cell adhesion mechanisms creates gaps in the intercellular space that allow diffusion of FITC-Dextran into the bottom chamber, so the amount of FITC-Dextran that diffuses is related to the amount of intercellular space, which is representative of vascular permeability.

## III. Precautions and Limitations

1. For Research Use Only. Not for use in diagnostic procedures.
2. The physical, chemical, and toxicological properties of these products may not yet have been fully investigated; therefore, Trevigen recommends the use of gloves, lab coats, and eye protection while using these chemical reagents. Trevigen assumes no liability for damage resulting from handling or contact with these products.
3. The CultreCoat<sup>®</sup> Vascular Permeability Assay contains reagents that may be harmful if swallowed, or come in contact with skin or eyes. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

Material safety data sheets are available on request.

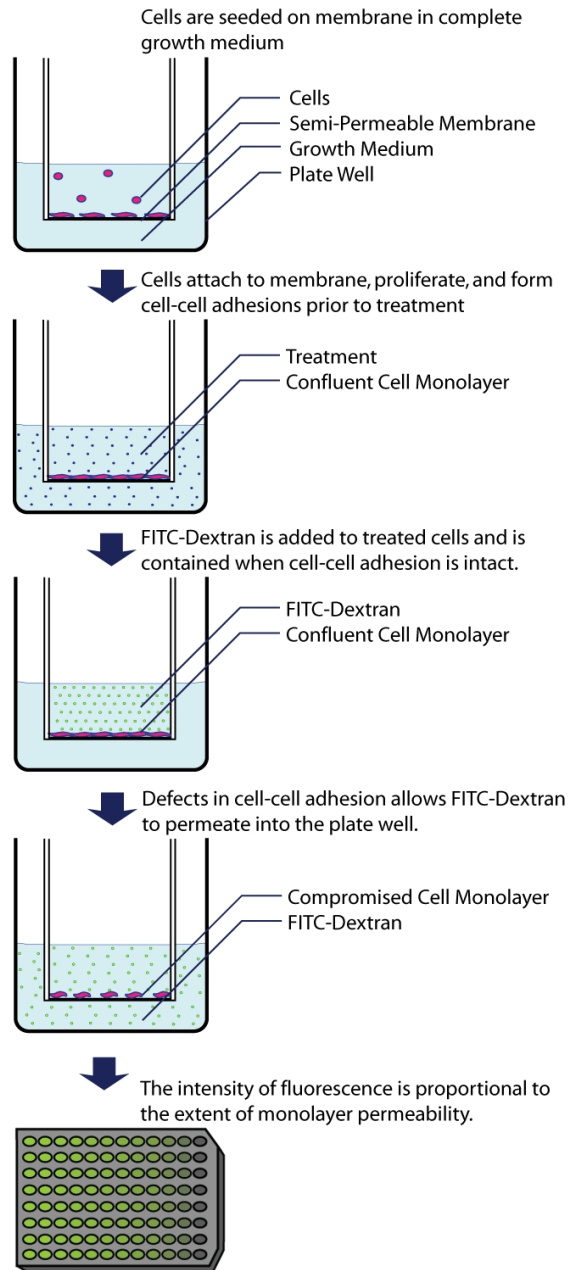


Figure 1. Illustration of protocol for the CultreCoat Vascular Permeability Kit.

#### IV. Materials Supplied

<u>Component</u>	<u>Quantity</u>	<u>Storage</u>	<u>Catalog#</u>
Vascular Permeability Chamber	each	4 °C (Desiccated)	3475-096-01
FITC-Dextran	100 µl	4 °C	3475-096-02

#### V. Materials/Equipment Required But Not Supplied

##### Equipment

- 1 - 20 µl, 20 - 200 µl, and 200 - 1000 µl pipettors
- 37 °C CO<sub>2</sub> incubator
- Laminar Flow Tissue Culture Hood
- Low speed centrifuge and tubes for cell harvesting
- Hemocytometer or other means to count cells
- 50 and 500 ml graduated cylinders
- 20 °C and 4 °C storage
- Ice bucket
- Standard light microscope (or inverted)
- Pipette helper
- Timer
- Vortex mixer
- Fluorescent 96-well plate reader, top reader (485 nm excitation, 520 nm emission)
- Computer and graphing software, such as Microsoft® Excel®.

##### Reagents

- Cell Harvesting Buffer; EDTA, trypsin, or other cell detachment buffer.
- Complete Culture Growth Medium, as recommended by cell supplier.
- Basal Medium, Complete Culture Growth Medium without serum and other supplements.
- Chemoattractants or pharmacological agents for addition to culture medium.
- Starvation medium: basal medium with 0.5% FBS.
- Sterile PBS or HBSS to wash cells.
- Distilled, deionized water
- Trypan blue or equivalent viability stain

##### Disposables

- Cell culture flask, 25 cm<sup>2</sup> or 75 cm<sup>2</sup>
- 50 ml tubes
- 1 - 200 µl and 200 - 1000 µl pipette tips
- 1, 5, and 10 ml serological pipettes
- Gloves

## VI. Reagent Preparation

### 1. Vascular Permeability Chamber

Rehydrate collagen I coated chambers using 50 µl of warm (37°C) Complete Culture Medium for 2 hours at 37 °C prior to starting assay.

### 2. FITC-Dextran

Dilute reagent 1:100 using Complete Culture Medium, and add 50 µl in the top chamber for each sample (except background control); dilution may be optimized if needed. For optimal stability, dilute only as needed.

## VII. Assay Protocol

**These procedures should be performed in a biological hood utilizing aseptic technique to prevent contamination.**

### A. Vascular Endothelial Cell Culture

Subject cells may be prepared for investigation as desired. The following procedure has been designed using HUVECs. Other cell lines/types may require optimization of seeding concentrations and incubation periods for best results.

1. Cells should be passaged 2 or 3 times prior to use in the assay, and adherent cells need to be no greater than 90% confluent. Each chamber requires approximately 100,000 cells (may vary by cell line), and a 25 cm<sup>2</sup> or 75 cm<sup>2</sup> flask will yield approximately 1 x 10<sup>6</sup> or 3 x 10<sup>6</sup> cells, respectively. Plan to have enough cells to accommodate all samples; insufficient cell densities will adversely affect the assay.
2. Prior to harvest, visually inspect cells, and record cell health, relative number, and morphology.
3. Cells should not be used if they are fully confluent, appear unhealthy, or exhibit impaired proliferation, and primary cell lines should not be used beyond passage 10.

### B. Preparation of Vascular Monolayer

**Note: Warm all cell culture medium to 37°C prior to use.**

4. To evaluate vascular permeability, controls need to be set up for background (no FITC-Dextran), 100% Permeability (no cells), and no treatment. Each control and experimental condition should be evaluated in replicates of four or more wells for optimal statistical significance.
5. Rehydrate the collagen I-coated top chamber by adding 50 µl of complete culture medium to each well, and incubate at 37 °C in a CO<sub>2</sub> incubator for two hours.
6. Harvest Cells.
  - A. Wash cells two times with sterile PBS or HBSS. Use 5 ml per wash for a 25 cm<sup>2</sup> flask and 10 ml per wash for a 75 cm<sup>2</sup> flask.

- B. For 25 cm<sup>2</sup> or 75 cm<sup>2</sup> flask, add 1 ml or 2 ml, respectively, of Cell Harvesting Buffer (see *Materials/Equipment Required But Not Supplied*), and incubate at 37°C for 5 to 15 minutes (until cells have dissociated from bottom of flask).
  - C. Transfer cells to a 15 ml conical tube, and add 5 ml of Complete Culture Medium (see *Materials/Equipment Required But Not Supplied*).
  - D. Centrifuge cells at 200 x g for 3 minutes to pellet, remove quenching medium, and resuspend cells in 2 ml of Complete Culture Medium. Cells may need to be gently pipetted up and down using a serological pipette to break up clumps.
  - E. Count cells, and dilute to 2 x 10<sup>6</sup> cells per ml in Complete Culture Medium.
7. Add 50 µl of cells per hydrated top chamber (do not add cells to control wells), and add 150 µl of Complete Culture Medium to each bottom chamber. Incubate at 37°C in a CO<sub>2</sub> incubator for 72 hours or until a confluent cell monolayer is formed.

### C. Vascular Permeability Assay

**Note: Warm all cell culture medium to 37°C prior to use. Two plate bottoms are provided for your convenience: optimization of assay conditions (clear), and background signal minimization (black).**

8. If serum-starvation is not required, proceed to step 9. If it is needed, then carefully aspirate media from the top and bottom chambers. Quickly add 50 µl of starvation medium (basal culture medium containing 0.5% FBS), and add 150 µl starvation medium to the bottom chamber. Incubate for 6 to 24 hours.
9. If not testing compounds, then proceed to step 10. If testing compounds, then carefully aspirate media from the top and bottom chambers. Prepare treatment medium (containing test compounds, with or without serum). Quickly add 50 µl of treatment medium, and add 150 µl of treatment medium to the bottom chamber. Incubate at 37 °C in CO<sub>2</sub> incubator as desired.
10. Prepare FITC-Dextran (see Section VI.2.).
11. Add 150 µl of basal medium to the black assay chamber.
12. Carefully aspirate media from the top and bottom chambers, and transfer the top chamber to the black assay chamber.
13. Add 50 µl of FITC-Dextran to the top chamber, and incubate at 37°C in CO<sub>2</sub> incubator for 5 minutes.
14. To stop the reaction, remove top chamber, and read plate at 485 nm excitation, 520 nm emission.

## VIII. Data Analysis

1. Each condition should be evaluated in replicates of four or more data points for optimal statistical significance.
2. For assay samples, first average all wells for each condition (Table 2).
3. Next, subtract background from averages (Table 3).
4. Determine percent vascular permeability by dividing the relative fluorescent units (RFU) for each sample by the maximum (no cell) RFU (Table 4).
5. Graph the vascular permeability with standard deviations (Figure 1).

Table 1. Raw data (RFU):

Condition	Well 1	Well 2	Well 3	Well 4	Medium
background	186	191	194	208	EGM2 w/o FITC-dextran
no cells	4753	4773	4799	4775	EGM2
100,000 cells	546	647	671	587	EGM2
100,000 cells	4527	3844	3786	4583	EGM2 + Cytochalasin B

Table 2. Summarize data (RFU):

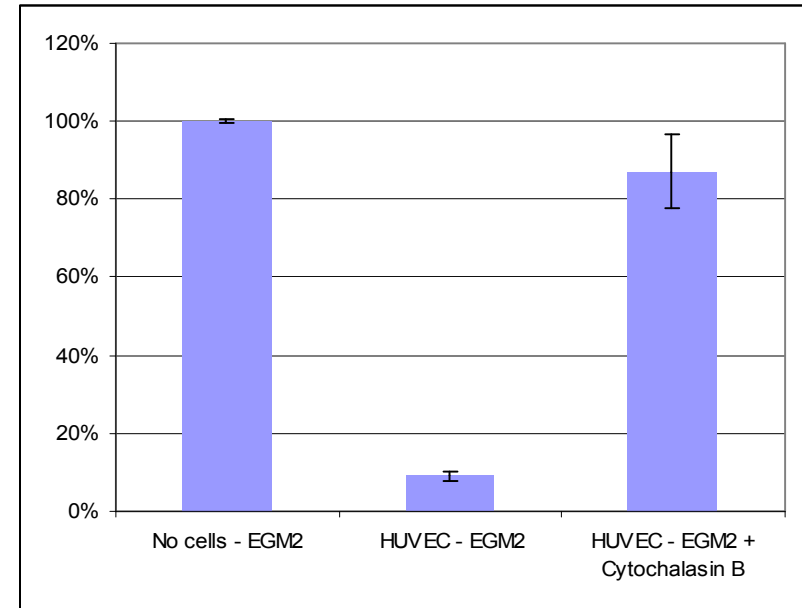
Condition	Average	Std Dev	Medium
background	195	9	EGM2 w/o FITC-dextran
no cells	4775	19	EGM2
100,000 cells	613	57	EGM2
100,000 cells	4185	429	EGM2 + Cytochalasin B

Table 3. Subtract background (RFU):

Condition	Average	Std Dev	Medium
no cells	4580	19	EGM2
100,000 cells	418	57	EGM2
100,000 cells	3990	429	EGM2 + Cytochalasin B

Table 4. Determine percent vascular permeability:

Condition	Average	Std Dev	Medium
no cells	100%	0%	Medium
100,000 cells	9%	1%	EGM2
100,000 cells	87%	9%	EGM2 + Cytochalasin B



**Figure 2. Cytochalasin B increases vascular permeability.** HUVECs were seeded at 100,000 cells/well and cultured for 72 hours at 37°C in a CO<sub>2</sub> incubator. Cells were treated with Cytochalasin B for four hours and evaluated for vascular permeability using the CultreCoat® 96 Well *In Vitro* Vascular Permeability Assay.

## IX. Troubleshooting

Problem	Cause	Solution
No Fluorescence in the no cell control	FITC-Dextran reagent was not added.	Add FITC-Dextran to the top chamber.
	The instrument is incorrectly configured.	Make sure plate reader reads from top if using black plate. Gain may need to be adjusted for optimal fluorescence range.

Problem	Cause	Solution
High Background	Medium additives may contribute to background fluorescence	Compare autofluorescence of Complete Culture Medium to Basal Medium
High Fluorescence in no treatment control	Insufficient cell density (no confluent monolayer)	Increase seeding density or extend cell culture period on top chamber.
	Insufficient cell health	Restart assay with healthy cell culture.

## X. References

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- Peisheng Hu, P., *et al.*, *Generation of low-toxicity interleukin-2 fusion proteins devoid of vasopermeability activity*. Blood, 2003, **101**: p. 4853-4861.

## XI. Related products available from Trevigen.

Catalog#	Description	Size
3475-024-K	CultreCoat® 24 well <i>In Vitro</i> Vascular Permeability Assay	24 samples
3455-024-K	Cultrex® 24 Well BME Cell Invasion Assay	24 inserts
3480-024-K	CultreCoat® 24 Well BME-Coated Cell Invasion Assay	24 inserts
3465-096-K	Cultrex® 96 Well Cell Migration Assay	96 samples
3465-024-K	Cultrex® 24 Well Cell Migration Assay	12 samples
3456-096-K	Cultrex® 96 Well Laminin I Cell Invasion Assay	96 samples
3457-096-K	Cultrex® Collagen I Cell Invasion Assay	96 samples
3458-096-K	Cultrex® Collagen IV Cell Invasion Assay	96 samples
3471-096-K	In vitro Angiogenesis Assay Endothelial Cell Invasion	96 samples

### Accessories:

Catalog#	Description	Size
3415-001-02	Cultrex® Human BME, PathClear®	1 mg
3420-001-01	Cultrex® Human Fibronectin, PathClear®	1 mg
3421-001-01	Cultrex® Human Vitronectin, PathClear®	50 µg
3400-010-01	Cultrex® Mouse Laminin I	1 mg
3440-100-01	Cultrex® Rat Collagen I	100 mg
3442-050-01	Cultrex® Bovine Collagen I	50 mg
3410-010-01	Cultrex® Mouse Collagen IV	1 mg
3430-005-02	Cultrex® BME with phenol red, PathClear®	5 ml
3431-005-02	Cultrex® BME with phenol red, reduced growth factor PathClear®	5 ml
3432-005-02	Cultrex® BME no phenol red, PathClear®	5 ml
3433-005-02	Cultrex® BME no phenol red, reduced growth factor PathClear®	5 ml
3430-005-01	Cultrex® BME with Phenol Red	5 ml
3432-005-01	Cultrex® BME; no Phenol Red	5 ml
3431-005-01	Cultrex® BME with Phenol Red; Reduced Growth Factors	5 ml
3433-005-01	Cultrex® BME no Phenol Red; Reduced Growth Factors	5 ml
3416-001-01	Cultrex® Bovine Fibronectin	1 mg
3417-001-01	Cultrex® Bovine Vitronectin	50 µg
3438-100-01	Cultrex® Poly-L-Lysine	100 ml
3439-100-01	Cultrex® Poly-D-Lysine	100 ml
3439-100-01	Cultrex® Cell Recovery Solution	100 ml
3437-100-K	Cultrex® Cell Staining Kit	100 ml
3450-048-05	CellSpense™	15 ml

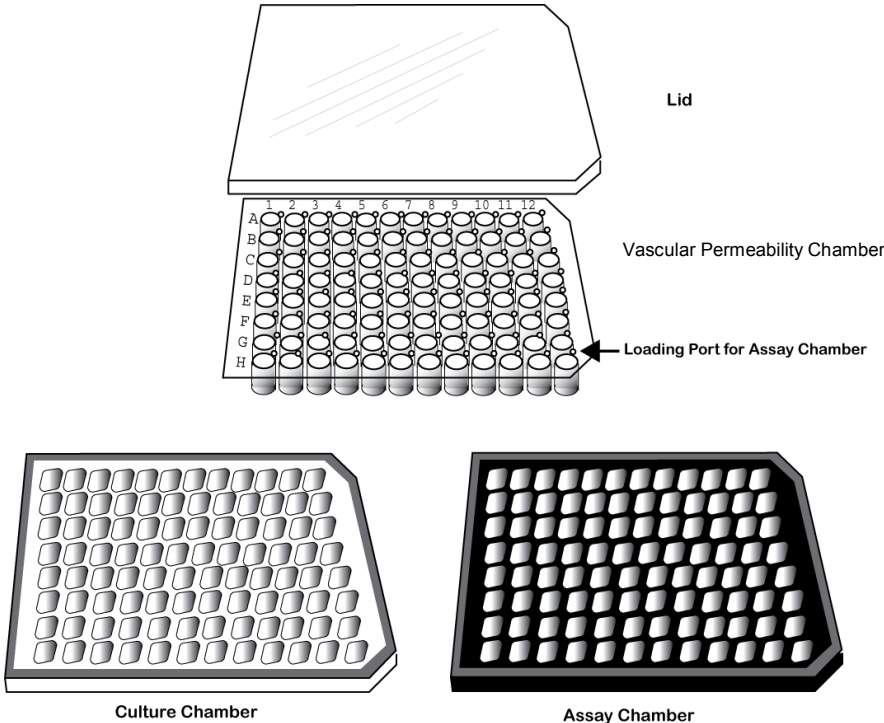
**Appendix B. Suggested sample configuration**

**XII. Appendix**

**Appendix A. Reagent and Buffer Composition**

**1. Vascular Permeability Chamber**

96 Well Boyden Chamber, 1.0 µm PET membrane pre-coated with collagen I, and black assay chamber compatible with 96 well fluorescent plate reader.



**2. FITC-Dextran**

FITC-labeled dextran. For optimal stability, dilute as needed.

	1	2	3	4	5	6	7	8	9	10	11	12
A	Background (no cells/no FITC-Dextran)					Condition 6				Condition 14		
B	Maximum Permeability (no cells)					Condition 7				Condition 15		
C	Minimum Permeability (no treatment)					Condition 8				Condition 16		
D	Condition 1					Condition 9				Condition 17		
E	Condition 2					Condition 10				Condition 18		
F	Condition 3					Condition 11				Condition 19		
G	Condition 4					Condition 12				Condition 20		
H	Condition 5					Condition 13				Condition 21		

**The product accompanying this document is intended  
for research use only and is not intended for  
diagnostic purposes or for use in humans.**

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