# QCM™ 24-Well Collagen-Based Cell Invasion Assay

**(Fluorometric)**

**Cat. No. ECM 552**

**Sufficient for analysis of 24 samples**

**FOR RESEARCH USE ONLY**
**Not for use in diagnostic procedures**

USA & Canada
Phone: +1(800) 437-7500 • Fax: +1 (951) 676-9209 • Europe +44 (0) 23 8026 2233
Australia +61 3 9839 2000 • Germany +49-6192-207300 • ISO Registered Worldwide
www.chemicon.com • custserv@chemicon.com • techserv@chemicon.com

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## Introduction

Penetration of the subendothelial basement membrane marks a critical turning point in the metastatic process. As proliferating neoplastic cells attempt to escape the primary tumor site, local invasion of the surrounding tissue (interstitial stroma) must occur. Neovascularization is initiated by expression of angiogenic factors (e.g. FGF, VEGF, HGF), providing nutritional requirements and access to the vascular system. Prior to penetrating the blood vessel endothelium and gaining access to the blood stream (intravasation), cancer cells must invade local tissues by degrading ECM components and ultimately, transverse the basement membrane. Once in circulation, these cells can form metastatic colonies at secondary locations, making this membrane a key invasive barrier.

The basement membrane surrounding the blood vessel endothelium is a thin, specialized network of extracellular matrix proteins (ECM) that serves many functions. Comprised of proteins and proteoglycans, such as collagen, laminin, entactin, fibronectin, heparin sulfate and perlecan, this membrane acts as a physical barrier between the epithelium and underlying tissues. It provides cell surface anchorage (via integrins, receptor kinases, and cell surface proteoglycans), induces cellular differentiation, gives architectural support, and limits the migration of normal cells. The ability of tumor cells to degrade the ECM components of the basement membrane and surrounding tissues is directly correlated with metastatic potential. By releasing proteolytic enzymes (e.g. MMP collagenases, plasminogen activators, cathepsins), cancer cells are able to breach the membrane and penetrate the blood vessel wall (1). Collagen, the primary structural element of the basement membrane and tissue scaffolding protein, represents the main deterrent in the migration of tumor cells.

The ability to study cell invasion through a collagen barrier, is of vital importance for developing possible metastatic inhibitors and therapeutics. The new CHEMICON QCM™ 24-well Collagen-based Invasion Assay (ECM552) provides an efficient, *in vitro* system for quantitative analysis of tumor cell invasion.

In the QCM™ 24-well Collagen-based Invasion Assay (ECM552), invaded cells on the bottom of the insert membrane are dissociated from the membrane when incubated with a specially formulated Cell Detachment Buffer. The invasive cells are subsequently lysed and detected by the patented CyQuant GR® dye (Molecular Probes) (2-3). This green-fluorescent dye exhibits strong fluorescence enhancement when bound to cellular nucleic acids (4).

The CHEMICON QCM™ 24-well Collagen-based Invasion Assay (ECM552) eliminates cell pre-labeling, fixing/staining, swabbing, and manual counting. The 24-well insert and homogenous fluorescence detection format allows for quantitative comparison of multiple samples.

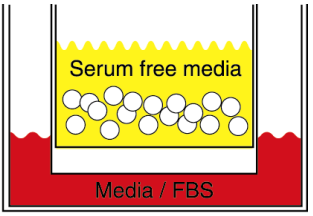
In addition, Chemicon continues to provide numerous migration, invasion, and adhesion products including:

- QCM™ 8µm 96-well Chemotaxis Cell Migration Assay (ECM510)
- QCM™ 5µm 96-well Chemotaxis Cell Migration Assay (ECM512)
- QCM™ 3µm 96-well Chemotaxis Cell Migration Assay (ECM515)
- QCM™ 96-well Cell Invasion Assay (ECM555)
- QCM™ 96-well Collagen-based Cell Invasion Assay (ECM556)
- 24-well Insert Cell Migration and Invasion Assay Systems
- CytoMatrix™ Cell Adhesion strips (ECM protein coated)
- QuantiMatrix™ ECM protein ELISA kits

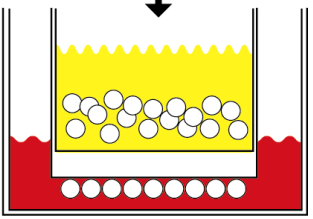
## Test Principle

The CHEMICON Cell Invasion Assay is performed in an Invasion Chamber, based on the Boyden chamber principle. Each kit contains 24 inserts; each insert contains an 8 µm pore size polycarbonate membrane coated with a thin layer of polymerized collagen. The collagen layer occludes the membrane pores, blocking non-invasive cells from migrating through. Invasive cells, on the other hand, migrate through the polymerized collagen layer and cling to the bottom of the polycarbonate membrane. Invaded cells on the bottom of the insert membrane are dissociated from the membrane when incubated with Cell Detachment Buffer and subsequently lysed and detected by CyQuant GR dye.

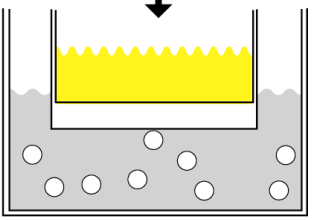
Cell suspension loaded into chamber



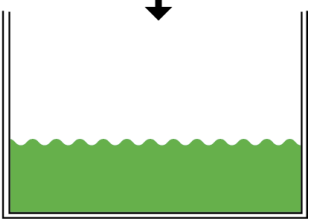

Invading cells migrate through and attach to bottom of membrane. Non-invading cells remain above.



Detach invaded cells in Cell Detachment Buffer



Lyse cells in Cell Lysis Buffer and detect cell numbers by CyQUANT® GR Dye*



## Application

The CHEMICON Cell Invasion Assay Kit is ideal for evaluation of invasive tumor cells. Each CHEMICON Cell Invasion Assay Kit contains sufficient reagents for the evaluation of 24 samples. The quantitative nature of this assay is especially useful for screening of pharmacological agents.

The CHEMICON Cell Invasion Assay Kit is intended for research use only; not for diagnostic or therapeutic applications.

## Kit Components

1. Sterile 24-well Cell Invasion Plate Assembly: (Part No. 90248) Two 24-well plates with 12 collagen–coated inserts per plate (24 inserts total/kit).
2. Cell Detachment Solution: (Part No. 90131) One bottle – 16 mL.
3. 4X Cell Lysis Buffer: (Part No. 90130) One bottle – 16 mL.
4. CyQuant GR Dye®[1]: (Part No. 90132) One vial – 75 µL
5. Forceps: (Part No. 10203) One each.

## Storage

Store kit materials at 2-8°C for up to their expiration date. Do not freeze.

## Materials Not Supplied

1. Precision pipettes: sufficient for aliquoting cells.
2. Harvesting buffer: EDTA or trypsin cell detachment buffer. Suggested formulations include a) 2 mM EDTA/PBS, b) 0.05% trypsin in Hanks Balanced Salt Solution (HBSS) containing 25 mM HEPES, or other cell detachment formulations as optimized by individual investigators.

   ***Note:*** *Trypsin cell detachment buffer maybe required for difficult cell lines. Allow sufficient time for cell receptor recovery.*
3. Tissue culture growth medium appropriate for subject cells, such as DMEM containing 10% FBS.

4. Chemoattractants (eg. 10% FBS) or pharmacological agents for addition to culture medium, if screening is desired.
5. Quenching Medium: **serum-free** medium, such as DMEM, EMEM, or FBM (fibroblast basal media), containing 5% BSA.

   ***Note:*** *Quenching Medium* ***must contain*** *divalent cations ($Mg^{2+}$, $Ca^{2+}$) sufficient for quenching EDTA in the harvesting buffer.*
6. Sterile PBS or HBSS to wash cells.
7. Distilled water.
8. Low speed centrifuge and tubes for cell harvesting.
9. $CO_2$ incubator appropriate for subject cells.
10. Hemocytometer or other means of counting cells.
11. Trypan blue or equivalent viability stain.
12. Fluorescence plate reader.
13. Sterile cell culture hood.

## Cell Harvesting

Prepare subject cells for investigation as desired. The following procedure is suggested for adherent cells only and may be optimized to suit individual cell types.

1. Use cells that have been passaged 2-3 times prior to the assay and are 80% confluent.
2. Starve cells by incubating 18-24 hours prior to assay in appropriate serum-free medium (DMEM, EMEM, or equivalent).
3. Visually inspect cells before harvest, taking note of relative cell numbers and morphology.
4. Wash cells 2 times with sterile PBS or HBSS.
5. Add 5 mL Harvesting Buffer (see Materials Not Supplied) per 100 mm dish and incubate at 37°C for 5-15 minutes.
6. Gently pipet the cells off the dish and add to 10-20 mL Quenching Medium (see Materials Not Supplied) to inactivate trypsin/EDTA from Harvesting Buffer.

7. Centrifuge cells gently to pellet (1500 RPM, 5-10 minutes).
8. Gently resuspend the pellet in 1-5 mL Quenching Medium, depending upon the size of the pellet.
9. Count cells and bring to a volume that gives 0.5–1.0 x $10^6$ cells per mL.
10. If desired, add additional compounds (cytokines, pharmacological agents, etc.) to cell suspension.

## Assay Instructions

*Perform the following steps in a tissue culture hood:*

1. For optimal results, bring plates and reagents to room temperature (25°C) prior to initiating assay.
2. Sterilize forceps with 70% ethanol and handle inserts with forceps.
3. Add 300 µL of prewarmed serum free media to the interior of the inserts. Allow this to rehydrate the collagen layer for 15-30 minutes at room temperature.
4. After rehydration from step 3, carefully remove 250 µL of media from the inserts without disturbing the collagen –coated membrane.
5. Prepare a cell supension containing 0.5-1.0 x $10^6$ cells/mL in chemo-attractant-free media.
6. Add 250 µL of prepared cell suspension from step 5 to each insert.
7. Add 500 µL of serum free media in the presence or absence of chemo-attractant (e.g. 10% fetal bovine serum) to the lower chamber.

   ***Note:*** *Ensure the bottom of the insert membrane contacts the media. Air may get trapped at the interface.*
8. Cover plate and incubate for 24 - 72 hours at 37°C in a $CO_2$ incubator (4-6% $CO_2$).
9. Carefully remove the cells/media from the top side of the insert by pipetting out the remaining cell suspension, and place the invasion chamber insert into a clean well containing 225 µL of prewarmed Cell Detachment Solution. Incubate for 30 minutes at 37°C.
10. Dislodge cells completely from underside by gently tilting the invasion chamber plate back and forth several times during incubation. Remove the insert from the well.

11. Prepare sufficient Lysis Buffer/Dye Solution for all samples. Dilute the CyQuant GR Dye 1:75 with 4X Lysis Buffer (eg. 4 µL dye in 300 µL of 4X Lysis Buffer) and add 75 µL of this Lysis Buffer/Dye Solution to each well containing 225 µL cell detachment solution with the cells that invaded through the collagen-coated membrane. Incubate 15 minutes at room temperature.
12. Transfer 200 µL of the mixture to a 96-well plate (not included) suitable for fluorescence measurement.
13. Read with a fluorescence plate reader using 480/520 nm filter set.

## Calculation of Results

Results of the QCM™ 24-well Collagen-based Cell Invasion Assay may be illustrated graphically by the use of a "bar" chart. Samples without cells, but containing Cell Detachment Buffer, Lysis Buffer and CyQuant Dye are typically used as "blanks" for interpretation of data. A typical cell invasion experiment will include control chamber migration without chemoattractant. Cell invasion may be induced or inhibited in test wells through the addition of cytokines or other pharmacological agents.

Invaded cell number can be determined by running a fluorescent cell dose curve, as illustrated in Figure 1.

The following figures demonstrate typical invasion results. PE Cytofluor® 4000 with 480/520 nm filter set and gain setting of 65 was used. One should use the data below for reference only. This data should not be used to interpret actual assay results.

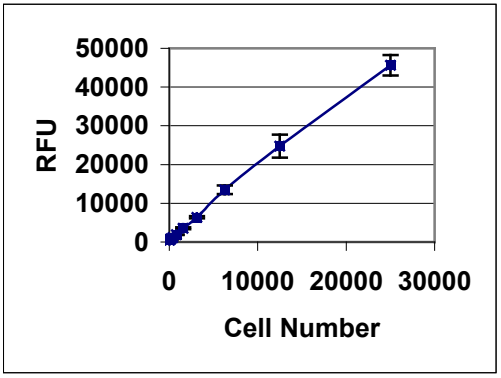
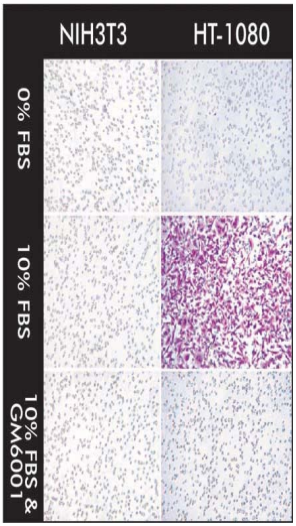



**Figure 1: Quantitation of HT-1080 Using the CyQuant GR Dye.** HT-1080 cells were resuspended in Cell Detachment Buffer; 150 µL of this cell suspension was mixed with 50 µL of 4X lysis buffer containing the fluorescence dye. Fluorescence was determined as described in *Assay Instructions*.

**A**




**B**

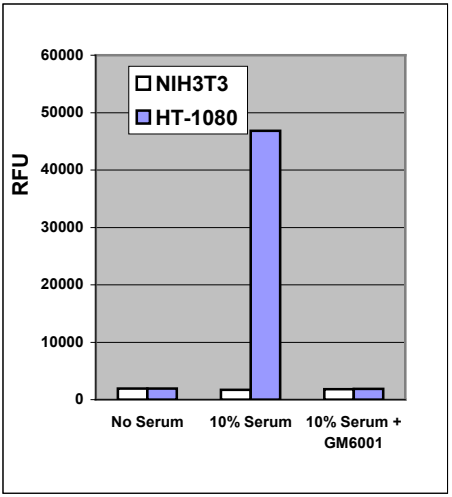



**Figure 2: Cell Invasion of HT-1080 vs. NIH3T3.** HT-1080 and NIH3T3 cells (+/- 25 µM MMP Inhibitor GM6001) were allowed to invade toward 10% FBS for 24 hrs. 250,000 cells were used in each assay. **A:** Invaded cells on the bottom side of the membrane were stained with 0.1% Crystal violet solution. **B:** Fluorescence measurements were taken according to *Assay Instructions*.

## References:


1. Egeblad M and Werb Z. (2002), New functions for the matrix metalloproteinases in cancer progression, *Nat Rev Cancer* **2**:161-74.
2. CyQUANT GR® is a registered trademark of Molecular Probes, Inc. The reagent is licensed from Molecular Probes, Inc. and is for use in kits sold by Chemicon International, Inc. for the monitoring of cell invasion and cell migration only.
3. Gildea JJ, Harding MA, Gulding KM, and Theodorescu D (2000), Transmembrane motility assay of transiently transfected cells by fluorescent cell counting and luciferase measurement, *Biotechniques* **29**, 81-86.
4. Jones LJ, Gray M, Yue ST, Haugland RP, and Singer VL (2001), Sensitive determination of cell number using the CyQUANT cell proliferation assay, *J Immunol Methods* **254**, 85-98.
5. Albini, A., Iwamoto, Y., Kleinman, H.K., Martin, G.R., Aaronson, G.R., Kozlowski, J. M., and McEwan, R.N. (1987). A rapid in vitro assay for quantitating the invasive potential of tumor cells, *Cancer Res.* **47**, 3239-3245.
6. Repesh, L.A. (1989). A new in vitro assay for quantitating tumor cell invasion, *Invasion Metastasis* **9**, 192-208.
7. Terranova, V.P., Hujanen, E.S., Loeb, D.M., Martin, G.R., Thornburg, L., and Glushko, V. (1986) Use of reconstituted basement membrane to measure cell invasiveness and select for highly invasive tumor cells, *Proc. Natl. Acad. Sci. USA* **83**, 465-469.
8. Liotta, L.A. (1984) Tumor invasion and metastasis: role of the basement membrane, *Am. J. Pathol.* **117**, 339-348.

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