



**PTC1**

**Paint Test Cell Kit**



**Operator's Manual**

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Replacement parts for this kit are available from Gamry Instruments, Inc. Optional parts may be available from Gamry Instruments, or from third-party vendors. Contact your local Gamry sales representative to discuss any special requirements or accessories that you need.

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## Introduction

The Gamry Instruments' PTC1 Paint Test Cell kit is a simple, inexpensive cell used for electrochemical corrosion testing. This cell was originally developed by Dr. Richard Granata of Lehigh University.

The PTC1 was designed for electrochemical-impedance testing of flat, coated metal specimens. It can also be used for testing corrosion of bare metal samples in highly conductive media.



The PTC1 is not recommended for testing bare metals in more resistive solutions.

## Unpacking and Checking a Cell Kit

This section is primarily intended for the user who has just received a new Paint Test Cell Kit.

### Checking for Shipping Damage

Your new kit was shipped disassembled to minimize shipping damage. All of the pieces were carefully packaged in anticipation of rough handling in shipment. Unfortunately, no matter how carefully glass pieces are packaged, damage sometimes occurs.

When you first receive your kit, please check it for any signs of shipping damage. Be especially careful if the shipping container shows signs of rough handling.

Obviously, the glass piece is the most susceptible to damage. Check the glass piece for chipping and small cracks as well as for major damage.



**Warning:** Never use any glass parts that are chipped or cracked. Any damage to glass increases the probability of additional damage. Broken glass can have extremely sharp edges that represent a significant safety hazard. Injuries from broken glass can be quite severe.

If any parts were broken in shipment, please take a photograph and contact our USA facility or your local Gamry representative as soon as possible. In most cases, Gamry should have replacement parts in stock. Please retain the shipment's packaging material for a possible claim against the shipping company.

### Parts List

Please check the contents of your kit versus the packing list in Table 1. When shipped, all of the components should be labeled with their Gamry part number. If you are checking the completeness of an older kit, most of the components are shown in photographs throughout this manual.

**Table 1**  
**Parts in Paint Test Cell Kit PTC1**

Quantity	Part Number	Description
1	930-00026	Cell Body, PTC1, with O-ring
1	935-00035	Stopper, Rubber, PTC1
1	935-00036	Clamp, PTC1, Ace 7669-18
1	935-00039	PTC1 Base assembly
1	935-00014	Graphite Rod, 8 mm × 6" (half of 935-03)
2	935-00049	PortHole™ electroplating tape, 1 cm <sup>2</sup>
2	935-00050	PortHole™ electroplating tape, 3 cm <sup>2</sup>
2	935-00051	PortHole™ electroplating tape, 10 cm <sup>2</sup>

## Assembly of the Cell Top

This section tells you how to assemble the top of the cell.



**Warning:** The reference and counter electrodes can break during this procedure. If you are not careful, a broken electrode can pierce your hand. Broken glass can have extremely sharp edges that represent a significant safety hazard. Injuries from broken glass can be quite severe.

### Important notes

- Lubricate the reference electrode with water before inserting it into the top.
- Grasp the electrode as near to the stopper as possible and twist the electrode as you are inserting it.
- When inserting the electrodes, hold the stopper between your thumb and your first finger.



**Warning:** Do not place your palm under the stopper.

- Double-check that you insert each electrode into its correct hole.

### Procedure

1. Locate the rubber stopper. Notice that the holes in the stopper have different diameters.
2. Gently push the graphite counter electrode into the smaller of the two holes in the top.
3. Insert the counter electrode until approximately 5 cm of the electrode extends below the top.
4. Wet the outside of the reference electrode with a few drops of water.
5. Gently push the reference electrode into the larger of the two holes in the top.

Insert the reference electrode until approximately 5 cm of the electrode extends below the top.



## Requirements for Metal Samples

If you use a rectangular metal sample, it must measure at least 6 cm on each side. The sample must be flat enough that a water-tight O-ring seal can be made.

The area to be tested must be within 2 cm of one of the edges on the sample. If it is farther away, the clamp cannot hold the cell onto the sample.

The minimum sample thickness depends on the type of metal. Generally about 0.05 mm is a useful minimum thickness. Samples between 7 mm and 15 mm thick require testing without the base.

Painted samples must have an area outside of the cell free from paint. This area is used to make electrical contact with the sample.

## Chemical Compatibility

The O-ring used in this cell is made from an ethylene/propylene elastomer. The top is made from a carbon-filled natural rubber. These materials are not universally chemically resistant. They should give acceptable performance with dilute acids, bases, and chloride salts.



We do not recommend use of the PTC1 with strong acids and bases, oxidizing or reducing agents, or organic solvents. Gamry Instruments is not responsible for damage caused to the cell, your laboratory, or your person by use of the PTC1 with an incompatible test solution.

## Cell Setup

1. Test your thin samples in a setup that includes the PTC1 base (a polypropylene block equipped with four rubber feet). Place a sample on the side of the base without the feet.
2. Place the cell body on top of the sample, making sure that the O-ring fits in the groove on the cell body. This O-ring makes a watertight seal between the cell body and the sample.
3. With the clamp, affix the glass to the base. Use the knurled knob on the cell clamp to compress the O-ring.



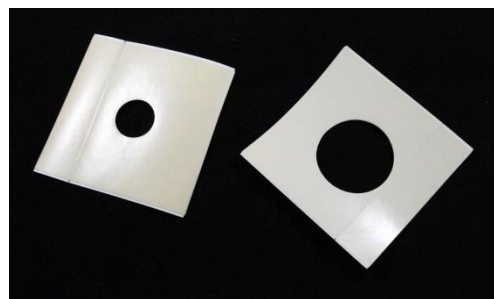
4. Fill the cell with the test solution (approximately 40 mL of solution).
5. Place the top, with the reference and counter electrode already in place, on the cell. Make sure that the protective cap is removed from the reference electrode. With the top lightly pressed into the cell body, you should have a watertight seal.
6. Before making the connections to the test instrument, check that the cell is not leaking from the O-ring seal. After you are sure the cell is not leaking, connect the test instrument. The metal sample is used as the working electrode.

## Working Electrode Area

The area of the sample exposed to the test solution varies somewhat because of variation in the compression in the O-ring and variation in the glass cell body. Gamry Instruments measured the active area to be nominally 14.6 cm<sup>2</sup>. At worst, the actual area should be within  $\pm 5\%$  of this value.

## PortHole™ Electrochemical Sample Masks

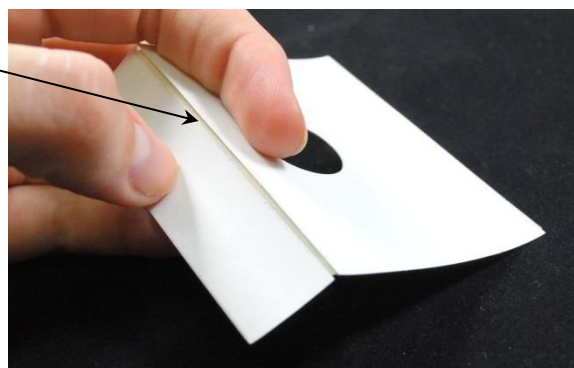
PortHole Electrochemical Sample Masks define a specified area of a flat metal sample for electrochemical testing with the PTC1. PortHole masks are available in areas of 1, 3, or 10 cm<sup>2</sup> to accommodate any specimen. PortHole masks are fabricated from vinyl 3M™ Electroplating Tape 470.



PortHole™ masks.

Before applying the PortHole mask, degrease the surface using a suitable solvent. Remove the backing from the PortHole mask and place it carefully on the metal sample. Roll the PortHole mask over the metal sample to make sure that the tape does not crimp around the perimeter of the hole.

Carefully press down on the entire surface of the PortHole mask. Pay special attention to the perimeter of the hole: it is important to get good adhesion on the perimeter to minimize the possibility of crevice corrosion. Use a spatula or a round implement to press the edge of the tape firmly against the metal sample.



Place the cell body and O-ring of the PTC1 on the PortHole mask so that the exposed area of the sample is enclosed. Clamp the cell body firmly as described in Cell Setup, and proceed normally.

When the experiment is complete, remove the PortHole mask and discard. If the sample-electrolyte system tends to undergo crevice corrosion, visually examine the periphery of the hole with a magnifier. If any crevice corrosion is detected, discard the data for that sample.

If crevicing is particularly prevalent with any sample, consider the following approach. Place the sample in a benign electrolyte and apply +0.75 volts for 60 seconds to form an oxide film. Remove the sample from the electrolyte and dry it. Place a PortHole mask in position on the sample. Manually remove the oxide film from the area exposed by the PortHole mask using a fine emery cloth or a pencil eraser. Perform the electrochemical experiment.

## Maintenance

### Replacement Parts

All of the part numbers for replacement parts (except for the O-ring) are listed in Table 1. The cell body includes an O-ring. O-rings can also be ordered separately using part number 935-00037 (a package of five O-rings).

### Reference Electrode Maintenance

It is generally best to leave both electrodes in the cell top when the cell is not in use. Use the small protective cap shipped with the reference to cover the electrode tip if you want to store the top dry. Many chemists believe that reference electrodes should be stored immersed in solution. If you wish to do so, place the top on top of a beaker containing distilled water or aqueous KCl.

Move the tubing over the breather hole in the side of the electrode to allow a small opening whenever the electrode is in use. After a long period of use, you may need to add KCl crystals to the reference filling solution or replace the filling solution entirely.

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