

***This document was written to help researchers, new to diffusion studies, choose a diffusion cell system that is best suited to their work.***

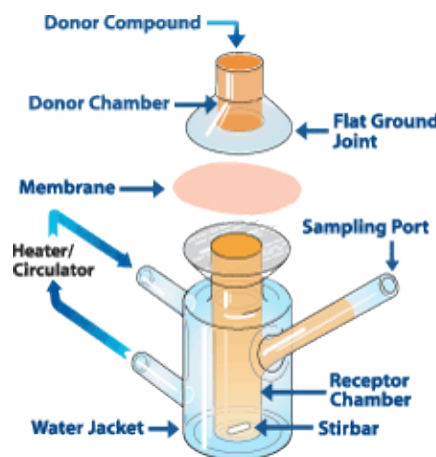
## Terms

**Diffusion** - the concentration gradient driven, and random movement of particles

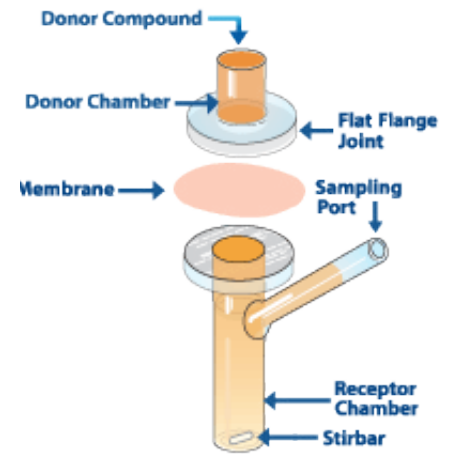
**Membrane** - any biological or manmade layer of material

**Diffusion Cell** - a donor chamber, receptor chamber, membrane, and cell clamp to hold the assembly together

**Donor Chamber** - the part of a diffusion cell, where the compound of interest, is placed at the beginning of a study



*Jacketed Franz Cell  
With Flat Ground Joint*



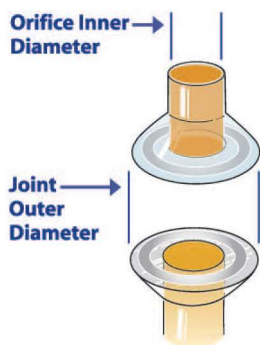
*Unjacketed Franz Cell  
With Flat Flange Joint*

**Receptor Chamber** - the part of a diffusion cell, into which particles of the compound of interest may migrate

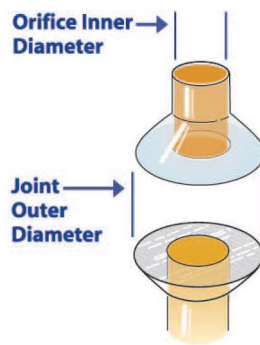
**Joint** - the interface between the donor chamber and receptor chamber, or the interface surface of each chamber

**Orifice** - the hole in the joint surface of either the donor or receptor chamber, usually the receptor chamber, the same hole covered by the membrane

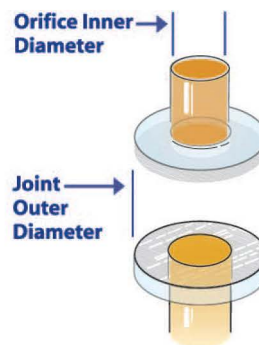
### O-ring Joint-00



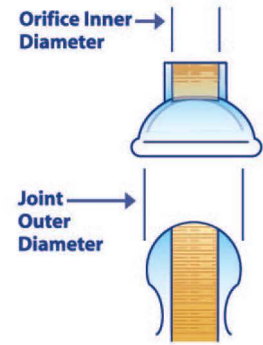
### Flat Ground Joint-01



### Flat Flange Joint-02



### Spherical Joint-03



**Orifice Diameter** - the diameter, in metric units and usually millimeters, of the orifice - the orifice diameter is how diffusion cell size is specified. A 9mm Franz Cell has a 9mm orifice diameter. A 15mm Side-Bi-Side Cell has a 15mm orifice diameter.

**Orifice Area** - the area of the orifice in centimeters, which is important to know for diffusion calculations

**Receptor Volume** - the volume of the receptor chamber in milliliters, which is important to know for diffusion calculations

**Sampling Arm** - a port through which a device is inserted, to withdraw receptor fluid from the receptor chamber. Some unjacketed Franz Cells have large diameter sampling arms for pouring out all the receptor fluid for analysis, instead of just removing a sample. These are called dump cells.

## Diffusion Cell Basics



*Side-Bi-Side Cell*

**Franz Cell** - a versatile blown glass diffusion cell which locates the membrane horizontally and is usually used in the development of transdermal products having a donor chamber open to the air and a stirred receptor chamber

**Side-Bi-Side Cell** - a blown glass diffusion cell which locates the membrane vertically between the donor chamber and receptor chamber, both of which are stirred and closed to the air



*Franz Cell*

**In-Line Cell** - a polychlorotrifluoroethylene (CTFE) flow type diffusion cell which locates the membrane horizontally and has a donor chamber open to the air, a very small receptor chamber, and is almost always used in an automated sampling system

**Flow Porting** - additional ports added to the receptor chamber of a Franz Cell or Side-Bi-Side Cell which allow liquids to be pumped through the chamber to draw off the compound of interest as it permeates through the membrane. Flow porting may also be added to donor chambers to draw off volatiles or recirculate other fluids or gasses.

**Heating Jacket** - a glass chamber around the receptor chamber of a Franz Cell, or each chamber of a Side-Bi-Side Cell, that allows circulated liquid, usually water, to maintain other than ambient temperature in the diffusion cell



*Jacketed Franz Cell*

*Unjacketed Franz Cell*

**Jacketed Cell** - a diffusion cell with a heating jacket

**Unjacketed Cell** - a diffusion cell without a heating jacket that may be placed in a temperature controlled environment to achieve the desired temperature, when other than ambient temperature is required.

**Important Notes** - PermeGear makes three varieties of diffusion cells, Franz Cells, Side-Bi-Side Cells, and In-Line Cells. "Franz Cell" is sometimes used erroneously when "diffusion cell" is what was intended. A Franz Cell is a type of diffusion cell. All Franz Cells are diffusion cells but not all diffusion cells are Franz Cells. "Franz" is correctly pronounced when it rhymes with lands, not fronds.

## Diffusion Cell Selection

It is possible to successfully use a diffusion cell for a purpose other than what it was primarily designed for. Clever researchers are always conjuring up novel adaptations. If you feel that your study requires something other than the norm, don't be afraid to ask us for help. PermeGear makes over 800 different models of Franz and Side-Bi-Side Cells.

Generally, Franz Cells are used in the development of transdermal applications. Side-Bi-Side Cells are used when permeation through membranes inside the body are studied. In-Line Cells are primarily used in transdermal research. Any of these cells may be used for other applications if careful consideration is given to the study design.

## Franz Cells

As noted in the Terms section above, a Franz Cell is referred to by its orifice diameter. A 25mm Franz Cell has an orifice of 25mm. A standard 25mm Franz Cell also has a receptor volume of 20ml but the cell should not be referred to as a “20ml Franz Cell”; it is a 25mm Franz Cell with a 20ml receptor volume. The outer diameter of the joint on a 25mm Franz Cell is about 42mm, but the cell is properly referred to as a 25mm Franz Cell. Any membrane with an outer diameter that is the same size as the orifice of a Franz Cell cannot be used with that Franz Cell, as the membrane will fall into the receptor chamber.

PermeGear manufactures Franz Cells with 5mm, 7mm, 9mm, 11.28mm, 15mm, 20mm, 25mm, 30mm, and larger orifice diameters. Experience has shown that Franz Cells with orifice diameters smaller than 5mm, do not expose enough of the membrane to the receptor fluid and detectability of the subject compound may not be possible.

When mounting a membrane on a Franz Cell receptor chamber, it is critical that the membrane completely cover the receptor chamber orifice. The larger the orifice, the larger the margin or distance between the edge of the orifice and the outer edge of the membrane, should be. When working with Franz Cells up to 9mm in orifice diameter, it is recommended that there be at least a 3mm margin. When using a Franz Cell with an orifice diameter of 11.28mm and 15mm, there should be at least a 5mm margin. 20mm and 25mm Franz Cells should have at least a 7mm margin. When using a biological membrane which tends to be slippery, particular care must be taken so the tissue remains in place over the orifice and does not slide out of position and expose the donor chamber directly to the receptor chamber. Improper placement of the tissue will also result in leakage of the compound from the donor chamber out through the periphery of the joint.



5mm Franz Cells are often used for studying permeation into and through mucosal tissues. Bigger cells may be used if tissue specimens large enough to be properly used in those cells are available.

9mm is the orifice diameter most used when working with human skin. Other sizes may be used if desired. Important considerations in cell selection when using human tissues are; the availability and cost of the tissues, regulatory requirements, and biohazardous material concerns.

15mm Franz Cells are commonly used with polymer membranes and artificial membranes. One reason for this is that many membranes are supplied 25mm in diameter so they cover the entire orifice with an appropriate margin. Also, the outer diameter of a 15mm flat ground joint is about 28mm, so the edge of the membrane is neatly inside the joint.

When using a Franz Cell there may be evaporation of fluid from either chamber out through the side of the joint. It is recommended to wrap the joint of an assembled Franz Cell with parafilm to help prevent evaporation. The end of the sampling arm should also be covered using three layers of parafilm.